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NOVEMBER-DECEMBER 1958



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The members of this Association, mindful of the vital importance to national defense of chemistry, allied sciences, and the arts derived from them, have joined together as a patriotic obligation to preserve the knowledge of, and interest in, national defense problems derived from wartime experience; to extend the knowledge of, and interest in, these problems; and

to promote cooperative endeavor among its members, the Armed Services, and civilian organizations in applying science to the problems confronting the military services and other defense agencies, particularly, but not exclusively in fields related to chemical warfare. (From Art. II, AFCA Constitution.)

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POLICY

The fact that an article appears in this magazine does not indicate approval of the views expressed in it by any one other than the author. It is our policy to print articles on subjects of interest in order to stimulate thought and promote discussion; this regardless of the fact that some or all of the opinions advanced may be at variance with those held by the Armed Forces Chemical Association, National Officers, and the Editors. It is the responsibility of contributors, including advertisers, to obtain security clearance, as appropriate, of matter submitted for publication. Such clearance does not necessarily indicate indorsement of the material for factual accuracy or opinion by the clearing agency.

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FRONT COVER

To meet the occasional need for a standard cover design for THE JOURNAL, an arrangement accenting the Association's Seal has been prepared and is presented as our Front Cover for this issue. The design is intended only for occasional use. The general policy for the use of interesting front cover pictures still prevails.

PHOTO CREDITS

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A. F. C. A. AFFAIRS

DR. WEBER APPOINTED ARMY CHIEF SCIENTIFIC ADVISOR

Dr. Harold C. Weber of M.I.T., a Director of A.F.C.A., has been appointed Chief Scientific Advisor to the Army. He therefore has submitted his resignation as chairman of the U.S. Army Chemical Corps Advisory Council, in which capacity he has served since March 1955. The Chief Chemical Officer has appointed Dr. Ira L. Baldwin to succeed Dr. Weber as Council chairman.

Dr. Baldwin, who is Special Assistant to the President, and Professor of Bacteriology at the University of Wisconsin, Madison, Wisconsin, was among those who established the biological program of the Chemical Corps at Fort Detrick, and served as Technical Director until spring, 1945.

DR. READ JOINS JOURNAL STAFF

We are pleased to announce the appointment to our editorial staff of Dr. William T. Read, Sr., veteran educator, writer and lecturer, who recently retired from Civil Service employment as chemical consultant in the Office of the Chief of Research and Development of the Army.

It is expected that Dr. Read, through his wide acquaintance among scientists and engineers, particularly those in the chemical field, will open new sources and obtain for THE JOURNAL much interesting material in the form of original articles by chemists or other scientists engaged in work pertaining directly or indirectly to the National Defense.

In addition, Dr. Read will develop and edit, as a regular department of the magazine, a review, or digest, of current scientific and technical information in the chemical or allied fields, under the general title "DEFENSE CHEMISTRY." His first review appears in this issue. Contributions for this section of THE JOURNAL in the form of notes, reports, reprints of other publications, abstracts, etc., are invited. As appropriate, such material, including original signed articles, should be cleared for security before submission for publication. Contributions intended for Dr. Read's department should be marked for his attention.

Editor.

MIDWEST ADDRESSED BY ACTING SEC. OF ARMY

The Honorable Hugh M. Milton III, Assistant, and then the Acting, Secretary of the Army, was guest speaker at the annual dinner meeting of Midwest Chapter in Chicago on September 11, held in connection with the national meeting there of the American Chemical Society. Secretary Milton spoke of the "Role of the Professional Scientist in Army Research and Development." Before the meeting he toured the National Chemical Exposition in Chicago, visiting, among others, the exhibit of the U.S. Army Chemical Corps.

A.F.C.A. national president, Brigadier General Clifford L. Sayre, also spoke at the meeting and assisted in welcoming Secretary Milton.

The Chapter also reports a most successful gathering on September 6, when it joined with the Chicago Chemists Club in an all-day trip down the Chicago Inland

Waterways, including the Illinois Drainage Canal, the Ship and Sanitary Canal, the Calumet-Sag project, and Indiana Harbor. Mr. Robert Philbin, of the U.S. Army Corps of Engineers District Office, acted as guide for the party.

Acting Secretary of the Army Milton (left) is greeted by A.F.C.A. National President, Brig. Gen. Clifford L. Sayre (center) and Col. Walter W. Kuehler, Chemical Officer Fifth Army at Chapter dinner, at Hotel Conrad Hilton, Chicago.



MR. KIRKPATRICK HONORED



Mr. Sidney D. Kirkpatrick, editorial director and vice-president, McGraw Hill Book Company, New York, N.Y., and a Director-at-Large of A.F.C.A. was one of five of the nation's leading chemical engineers to receive a Founders Award presented at the Golden Jubilee Meeting of the American Institute of Chemical Engineers in Philadelphia last June.

Awards are given to members of the Institute whose achievements have advanced the profession.

Mr. Kirkpatrick, editorial director of the weekly magazine *Chemical Week* has been with McGraw Hill since 1921. A graduate of the University of Illinois in 1916, he is active in industry, education and technical literature. He served in both World Wars I and II. After World War II he was a postwar civilian expert with the Technical Intelligence Information Committee in Europe and later a member of the Chemical Advisory Committee for Industrial Information of the Atomic Energy Commission. He was president of A.I.Ch.E. in 1942 and served three terms on the Board of Directors and in 1945 was president of the Electrochemical Society.

WILMINGTON SCIENCE TEACHER HONORED BY A.F.C.A. CHAPTER

Wilmington Chapter presented the A.F.C.A. bronze plaque and a \$100 cash award to Dr. Ruth Cornell, chairman of the secondary science department of the Wilmington, Delaware, public schools, at a dinner meeting of the Chapter held at duPont High School on September 24. The presentation was made by Mr. Henry T. Clark of the Atlas Powder Company, president of the Chapter.

Dr. Cornell was selected by the Chapter as their candidate this year for the national A.F.C.A. Science Teacher Award of \$1000. At its meeting last summer the Board of Directors decided that the Association would present a plaque to each of the candidates entered in the national competition who was not selected for the

(Continued on page 4)

From Our New Honorary President

MAJOR GENERAL MARSHALL STUBBS, U. S. A.



TO MEMBERS OF THE ARMED FORCES CHEMICAL ASSOCIATION

YOU may be sure that I shall take a close personal interest in the affairs of the Armed Forces Chemical Association, both as a member and as Army Chief Chemical Officer. The programs of the AFCA and the principles for which it stands are of vital importance to the Chemical Corps and the entire defense organization.

The degree of success with which the Corps performs its assignments depends not only upon the efforts of the men and women within the Corps itself, but upon the cooperation and support it receives from outside the military establishment. It is gratifying that the Corps has in the Association so many good friends who understand its mission and stand ready to help when needed. This assistance has been invaluable to the Corps on many occasions.

We need your support now probably more

than ever. We are daily facing new challenges which make necessary a never ending re-evaluation of existing ideas and concepts. We must continually search for new ones. We must have the benefit of the best thinking that can be brought to bear upon our problems, and much of it must come from industry, science and engineering, which are so well represented among your membership.

You can expect that I will give my full backing to the Armed Forces Chemical Association and will do all in my power to assist it in achieving an even greater stature as a friend and supporter of the military services.

MARSHALL STUBBS
Major General, USA
Chief Chemical Officer

A.F.C.A. AFFAIRS

(Continued from page 2)

\$1,000 award. Dr. Cornell was selected by the Wilmington Chapter for her outstanding record as a teacher of chemistry and biology at duPont, many of her former students having gone on to take advanced college degrees in science. Also among her achievements was the initiating of the annual science exhibit by Wilmington public schools, and management of a summer science camp for students, which brought national recognition to the Wilmington school system.

GEORGIA TECH ROTC WINS TROPHY FOR M-1 RIFLE FIRING



Georgia Tech ROTC Student, Daniel Erlenkotter (right) receiving trophy from Maj. Robert K. Bradford for "high institution aggregate-average in M-1 rifle firing" at Fort Benning ROTC Camp, June 1958.

A.F.C.A. headquarters has learned through Mr. Andy Clark, president of the Georgia Tech Student Chapter, that Georgia Tech was the high institution in "aggregate average" in firing the M-1 rifle at the ROTC camp at Fort Benning, Georgia, this past summer. There were more than 1300 student-cadets from 29 colleges and universities in the Southeast and Puerto Rico at the camp. The Georgia Tech aggregate average was 184.45 and, as winner, Georgia Tech was selected to represent the Benning encampment at the annual "Warrior of the Pacific" M-1 rifle competition.

Upper picture shows Georgia Tech student-cadet David Erlenkotter, of The Presidio, California, receiving the high institution trophy for Georgia Tech from Major Robert K. Bradford, assistant PMS&T, Georgia Tech, who was an instructor at the camp.

Lower picture shows Georgia Tech student-cadets generating smoke during chemical warfare training at the camp. Left to right are: John C. Allen, of Atlanta, Ga.; Furman D. Knight, Sumter, South Carolina; Thomas Gurley, Hattiesburg, Mississippi; and William Denison, Atlanta.

Georgia Tech Students Generating Smoke.



L. W. MUNCHMEYER IS MADE WYANDOTTE VICE PRESIDENT



Mr. L. W. Munchmeyer, president of A.F.C.A. 1953-54, has been made a vice-president of his company, the Wyandotte Chemical Corporation, Wyandotte, Michigan. He now has charge of all of the company's industrial chemical manufacturing, comprising four major facilities. Previously he was the assistant general manager of the Michigan Alkali Division.

Mr. Munchmeyer recently retired from the active reserve of the Chemical Corps in which branch of the Army he served with distinction in World War II.

A native of West Virginia, he attended high school at Parkersburg and the State University at Morgantown, where he was graduated with a B.S. degree in Chemical Engineering in 1927. He joined the Corps of Engineers Reserve as a 2nd Lieutenant in 1926, transferring to the Chemical Corps in 1928. Entering on active duty in 1942 as a major, he had a number of important assignments in the Office of the Chief Chemical Officer in connection with procurement. He established procedures which became standard at all Chemical Corps installations. Toward the close of the war, then a colonel, he was assigned to Huntsville Arsenal, Alabama, as chief of arsenal operations, but later was recalled to the Chief's office where he organized and headed the Readjustment Division to execute the Corps' contract termination program. He was awarded the Legion of Merit on discharge from active duty.

Mr. Munchmeyer was employed for some years with E. I. duPont de Nemours & Co., Inc., and the Michigan Chemicals Corporation. Just before joining Wyandotte in 1955, he was assistant general manager of the Anasco Division of General Aniline & Film Corporation, Binghamton, N.Y.

He resides at Grosse Ile, Michigan.

HARRY WANSKER TO RETIRE DEC. 1 FROM UNITED-CARR FASTENER CORP.



Mr. Harry A. Wansker, vice president A.F.C.A., and chairman of the Meetings Committee, is to retire, on December 1, from his position as Director of Government Relations of the United-Carr Fastener Corporation, Cambridge, Mass.

He plans, however, to continue activity in the field of his business specialty, business management and government relations. He will serve on a part-time basis as consultant to United-Carr Fastener.

Mr. Wansker is also president of the New England Chapter of A.F.C.A. A graduate of Massachusetts Institute of Technology, he served as an officer of the Navy during World War I, and was established as a consultant management engineer when he joined United-Carr Fastener Corporation in 1943.

(Continued on page 7)

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MORE ABOUT THE 1ST CHEMICAL REGIMENT

LETTERS TO THE EDITOR



Colonel Bear and his wife Goldie in the backyard at their home at Sarasota, Florida.

cer of the Chemical Corps' Rocky Mountain Arsenal, Denver, Colorado, who served in the Regiment as a reserve officer under Colonel Bear has written to THE JOURNAL sending pleasing comments about the Regiment and its former C.O.

Colonel Bear's Letter

27 September 1958

In the last issue of THE JOURNAL you have an article about the Colors of the 1st Chemical Regiment. I would like to add my two cents worth in regard to the Colors. As you no doubt remember, the 1st Chemical Regiment was made inactive early in the thirties, and General Ditto, then Colonel Ditto, who was Chemical Officer of 3rd Corps Area, set it up as a Reserve Regiment, staffed with Reserve Officers. The headquarters of the Regiment and the 2d Battalion was set up in Philadelphia, the 1st Battalion in Richmond, and the 3d Battalion in Pittsburg. I had the honor and privilege of being appointed Commanding Officer and had associated with me in Philadelphia a very outstanding group of Reserve Officers.

We had a Regular Army Sergeant stationed in Philadelphia to handle our papers at Headquarters, which were at the Schuylkill Arsenal. The Battalions in Richmond and Pittsburg also had a fine group of officers. We had summer camps at Edgewood and also carried on training in chemical warfare with the Pennsylvania National Guard units.

After several years, Colonel Ditto sent us the Regiment Colors together with the Regiment's U.S. Flag, as he felt we deserved to have them.

In the fall of 1940 I was called to active duty and a month later all Staff Officers were called to active duty. Early in 1941 the rest of the officers of the Regiment, who could physically qualify, were called to active duty. We put all our possessions, including Colors and U.S. Flag in storage at Schuylkill Arsenal. In 1942 we had

Colonel Herbert K. Bear, 1582 South Drive, Cherokee Park, Sarasota, Florida, president of A.F.C.A. during its formative period, in a letter to the Editor, relates some interesting facts about this famous unit pertaining to the period he commanded it between World Wars I and II.

Colonel William J. Allen, Jr., now Commanding Officer

the Colors and U.S. Flag delivered to General Avery at Edgewood, where we believed it belonged, especially during the war. I have often wondered what happened to them, and am so happy that they have finally been properly taken care of. I am sure the other officers who served so ably with me will also be happy.

At one of our summer camps we presented to the Officers Club at Edgewood a silver cocktail service. We collected the money from the officers of the Regiment. In fact, we always paid our way and put money in our treasury—and at war end we had a \$500 Government bond, which we turned over to the Armed Forces Chemical Association. The silver service disappeared before the war's end, and I have often wondered what became of it . . .

Colonel Allen's Letter

2 October 1958

I have read with great interest Herb Bear's letter to you concerning the Colors of the 1st Chemical Regiment, copy of which was sent me. I think it is a wonderful, condensed history of the Regiment and its Colors, and without writing a detailed article, there is little I could add to what Herb had to say.

I would like to take this opportunity, though, to pay tribute to the outstanding organizational ability and personal leadership provided the Regiment by Herb Bear. Without Herb and his ability to attract and hold good officers, the Regiment never could have accomplished the many fine things that it did. My only regret was, and I am sure Herb shares this, that at the commencement of World War II it was necessary to break up the Regiment and send the well trained Regiment officers out as post, camp and station supply officers, while a group of reserve officers with miscellaneous backgrounds and mobilization assignments were brought in to activate the first replacement training center at Edgewood. The 1st Chemical Regiment was organized, staffed and trained to conduct training for units, and it would have been perfectly natural and certainly the best use of its talents had the 1st Chemical Regiment been set down at Edgewood as a nucleus around which the replacement center was organized. This is not to say that the officers sent to the center to organize it did not do a good job, but rather I feel it would have facilitated the activation the Replacement Center had the 1st Chemical Regiment organized it. You will no doubt recall that this was caused by the fact that the 1st Chemical Replacement Center was a Class II installation under the jurisdiction of the Chief, whereas the officers of the 1st Chemical Regiment were under the Third Corps Area jurisdiction for assignment.

When one looks at the rather fine record of the officers of the 1st Chemical Regiment who were called to active duty, I think it is indeed a fine tribute to the outstanding leadership and training ability of Colonel Herb Bear.

A.F.C.A. AFFAIRS

(Continued from page 4)

Among other interests, Mr. Wansker is active in promoting NATO cultural programs and is president of The Boston Regional Conference on NATO Affairs. He is a member of several Washington, D.C. and Boston Clubs. His home is at Newtonville, Mass.

SCIENCE TEACHER PLAQUE AWARD MADE AT MIDWEST CHAPTER DINNER

As part of the annual banquet program of Midwest Chapter at the Conrad-Hilton Hotel, Chicago, September 11, a bronze plaque was presented to Mr. Phillip Fordyce, Oak Park, Illinois, High School science teacher. Mr. Fordyce was the Chapter's nominee this year for the \$1,000 award to an outstanding science teacher selected from among Chapter nominees by the National Headquarters. The Board of Directors this year voted to extend recognition to all the Chapter nominees although the Association award of \$1,000 is given to only one of them. The presentation of the plaque in Chicago was made by Brig. Gen. Clifford L. Sayre, A.F.C.A.'s national president.



A.F.C.A. President Sayre (left) presents plaque to Mr. Fordyce at Chicago dinner.

DETTRICK CHOOSES PRENTICE



Colonel Joseph C. Prentice, Deputy Commander of the Chemical Corps Biological Warfare Laboratories is the new President of the Fort Detrick Chapter, A.F.C.A. Other officers elected to serve with Colonel Prentice are A. J. Rawson, Vice-Chairman and James A. Kime, Secretary-Treasurer.

The annual summer meeting of the Fort Detrick chapter was held July 31 at the home of Mr. and Mrs. Harold A. Chichester. Everyone of the 33 members and guests present seemed to have the same idea—"we ought to have these meetings more often." A picnic supper, which included cakes baked by Mrs. Chichester, Mrs. Kime and Mrs. Arnold G. Wedum, was followed by a report by Colonel Donald G. Grothaus, Commanding Officer, on the highlights of the recent annual meeting of A.F.C.A. at Atlantic City, N.J.

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NATO CONTEST WINNERS HOME FROM BOSTON TRIP

ARMY CHEMICAL CENTER, Md.—Six happy Edgewood High School students reluctantly returned to their homes and studies here following a most successful three-day tour of Boston where they attended the open sessions of the Atlantic Treaty Association assembly during the last week of September.

Winners of an essay-writing contest on NATO, the students won the trip as guests of the New England and Chesapeake Chapters of A.F.C.A. and the Boston Committee on NATO affairs.

Nancy Hinckley, Carol Baker, Susan Fisher, Bruce McCommons, Budne Reinke and Bill English, along with their chaperones, Mrs. Merrell Grafton, Mr. Warren Lowe and Mr. Lewis Walker, were guests, while in Boston of Mr. and Mrs. Thayer Baldwin.

The visit included a cruise aboard U.S. Coast Guard cutters. All expressed deep gratitude to the Chesapeake and New England Chapters, A.F.C.A.; Mr. Harry Wansker, chairman of the Boston NATO committee, and especially, their hosts, the Baldwins.

USE OF PAPER FOR SANDBAGS

WASHINGTON, (ANS)—Army engineers are developing a paper sandbag which could replace the traditional burlap bag used for years by the Army.

According to the Army, the knitted paper fabric does not ravel when punctured, resists the shock effects of a close blast as well as jute burlap and has a service life comparable to the jute sandbag in water.

SPACE LOGISTICS

Condensed from Panel Discussion at 4th Annual Military-Industry
Packaging and Handling Symposium, Washington, D.C., Sept. 30-Oct. 2, 1958

UNTIL recently it seemed that the principal concerns with chemistry in the long-range missile and outer space travel programs and projects had to do with the provision of super-power fuels and high heat-resistant materials. These, no doubt, are still of major importance, but it appears that progress in them has been at least sufficient for a shift in emphasis now to ways and means of adapting "payloads" to conditions of space environment—acceleration, temperature extremes, vacuum, and radiation of various sorts.

Chemistry again is looked to as one of the sciences—possibly the principal one—to provide the answers to these space problems—not only for assured round-trip voyage of human passengers, but also adequate protection of various sorts of supplies and equipment which will be needed. The protective devices and measures—from space suits to containers—apparently are all regarded as coming under the general heading of "Packaging."

A full afternoon's program on Space Travel, with special reference to "packaging" considerations, was included in the 4th Annual Joint Military-Industry Packaging and Handling Symposium, held under the auspices of the Department of Defense, in Washington, D. C., September 30-October 2. The program this year was specifically sponsored by the Navy with assists from other Services and various military-industry associations. The panel for the Space Logistics Session was composed of civilian scientists and engineers and officers of the three Armed Services.

Many points of interest were brought out in this meeting. It was stated that certain chemicals, such as coatings, plastics, and other materials, which are coming to have such an important influence on current living and economy (at least on Earth) will not be satisfactory for use in the outer space.

Another interesting observation made was that the relatively great weight and size of the Russian Sputniks do not, in themselves, prove a "scientific breakthrough."

In the belief that many members will find the generally non-technical discussions of this Panel fascinating reading, THE JOURNAL has undertaken to provide here a fairly complete coverage by excerpts from the report. Obviously magazine space limitations do not permit publishing the entire transcription.—Editor.

(The chairman and moderator of the Space Logistics Session was Mr. H. H. Koelle, Chief of the Future Projects Design Branch of the Development Operations Division of the Army Ballistic Missile Agency, Redstone Arsenal, Alabama. Mr. Koelle, who took an active part in the discussions, first introduced the ten members of the panel, consisting of Army, Navy and Air Force officers and civilian scientists, all connected directly or indirectly with missile projects of their respective Services.

Following are extracts from a transcription of the Panel presentation provided at the meeting in the Departmental Auditorium, Department of Commerce Building, Washington, D.C.)

Mr. H. H. Koelle

Space Logistics has been included in the symposium to acquaint the personnel attending with some of the problems and possible avenues toward solution which we will be facing in the near future.

In the age of space flight the packaging material will be as valuable and important as the actual payload, due

to the fact that the transportation cost per unit weight into orbit is many times larger than the actual material cost.

Space travel has been under discussion for many years by the far sighted scientists. It has been written about by various authors during the last 500 years. Most of us have read the Jules Verne's version of Voyage to the Moon, and we are all familiar with Buck Rogers and the Space Cadets, but we have given little serious thought to the actuality of man in space.

The time is rapidly approaching when we will be ready for true space flight. The degree of such a program will depend on many factors, one of the more important of which is that of logistics. The space flight program can never be accomplished until the problems of supply are licked. Packaging and materials handling will be conducted under conditions never experienced by us here on the surface of the Earth.

(Mr. Koelle called then upon panelist, Professor Hermann Oberth, Chief of the Special Projects Section of the Research Projects Laboratory at the Army Ballistics

Missile Agency. He had previously introduced Professor Oberth as an author of numerous books and as "without doubt, the greatest living proponent of space flight in the world today."

Professor H. Oberth

(Noting that there is no sharp division point between the atmosphere of the Earth and the first space-equivalent conditions, Professor Oberth opened his discussion with the assumption that the audience was in a spaceship 500 to 2,000 miles above the Earth's surface, and posed the question—"What will we meet there?")

First, we feel as though we are floating in the center of a huge hollow sphere. Although the sun shines more dazzling than anywhere on Earth, the sky will appear black; and if we shield our eyes, the stars will shine brightly and clearly.

Where the wall of the spaceship is dark colored and illuminated by the Sun, it will become hot. If a dark area is turned toward the sky, but not exposed to the Sun or another warm body, it will become cold. A white or shining surface will, in fact, neither cast warmth nor accept it. So if we have a vessel, that on one side is dark and on the other light, we can expect all temperatures between plus and minus 300 degrees Fahrenheit, according to its position relative to the Sun and the Earth.

In space, there is no morning, day, evening, or night. If the spaceship is in the sunlight, it will always be day, whatsoever shows the clock. If it enters into the shadow of the Earth, it will become night, but this night will never last more than 2 or 3 hours. During the darkness the spaceship will cool off, the darker its walls are the more it will cool. Also, the farther it is from Earth, the more it cools, because the Earth heats it by its radiation. In spaceships with dark walls, far enough from the Earth, the temperature can drop to minus 200°F; but if a relatively small cabin has shining walls, it may not be able to radiate all the warmth generated by the bodies of the crew, so that it will need black radiating panels on its walls, even in the Earth's shadow.

Further, in space there will be a nearly absolute vacuum. Space is filled with very thin gases—their pressure will be below a billionth of an atmosphere. Therefore, it is completely impossible to use any device utilizing the air for support like balloons, planes and so on. With the technical means of today, the only possibility of flight is the ballistic trajectory that allows a body, thrown with an adequate velocity to attain space conditions. The only means to change its velocity or direction are, at present, reaction motors that exhaust material and obtain thrust by recoil.

Due to this lack of air the bodies will follow freely the pull of the gravity, providing the engine is not working. The gravity-field changes with the distance from the Earth and other celestial bodies, but at a given place the gravity-acceleration is the same for all bodies. A big rock will fall as fast as a feather, this means a pilot can float freely in his cabin and feel no gravity.

We will then be able to move the heaviest bodies, if we can apply a force to them. But if we are freely floating in our cabin and stretch our arm, our body will get an impulse in the opposite direction. Therefore, the working with material will be rather unusual.

If we are outside the cabin, we will need a diver-type suit. (Slide 1) Here I shall illustrate my own proposal:

This suit is rather heavy. As we see, its weight does not hinder the spaceman, but rather it prevents reaction of his body if he is moving his arms or legs. It includes containers of air, devices for clinging on space-



—Official U.S. Navy Photograph
Examining a "space suit"—left, Brig. Gen. D. D. Flickinger, Surgeon, ARDC; right, Captain Ronald A. Bossee, U.S. Navy.

ships, such as claws, magnets, etc. Further, it contains a radio device for speaking because the space does not conduct sound. It includes a cooler which radiates to the sky the warmth produced by his body, a small rocket nozzle for moving, a cable to prevent his getting lost, a rear-view mirror so that he does not need to turn in order to see backwards. He can also turn by swinging his arms or legs around, but a rear-view mirror is more convenient. There are also foreseen, the problems of getting his arms into this harness and some other things, but I can't mention them in this short time.

There exist other proposals for space-divers, among them one by Dr. von Braun, in which the spaceman stays in a small chamber and actuates all grapples, claws and so on mechanically from the inside.

Another thing to be considered, is the cosmic radiation. It consists of electro-magnetic radiation, electrons, protons, neutrons, and A-particles. It is often referred to as all kinds of small-sized and fast-moving particles. In the literature one can find the most contradictory views about cosmic radiation depending on the author and the year of publication.

The first authors did not yet know about their existence. Then, when they were discovered, most scientists said: "Now, here is a thing that certainly will make manned space travel impossible." The discoverers themselves differed. It is true that they were also opponents of space travel, but they at least said: "If there would be no other reasons for the impossibility of space travel, the cosmic radiation would not hinder it."

The scientists, especially the German ones, are always against new inventions. They were also against the railway, the motorcars, the electric light, the man flight, and so on, as they occurred. I think that is because a scientist has too much to study. He does not wish to read new things, and does not wish to be considered a "phantast." On the other hand, having a pretext for doing so, he says, that the respective new idea is wrong.

When we began to explore the high altitudes by balloons and rockets, we found the radiation up to 300 miles much weaker than thought; but now the last experiments indicate much higher values for altitudes above 500 miles. It is not yet clear, however, whether that is a permanent effect or only a transient one caused by the sun-flare maxima and the geomagnetism.

My own proposal would be that we should begin to

build manned space-stations in relative low altitudes, where the cosmic radiation is not yet dangerous. There we should also build electric spaceships with thick-walled cabins, so that we are able to protect the crew against cosmic rays. The new step would then be flight to the Moon and the Asteroids in order to bring material for building, for operating electric reaction motors, and for protecting the walls of manned rooms. If we once have in the orbits of space stations enough such material, further space travel will not include any more major problems.

On this slide (Slide 2) I show you how a manned space station might be built. First, two carrier-spaceships are started. Each carries, among other things, a wire or cable. These are connected by spacedivers, and the two spaceships receive an impulse from their engines, so that they begin to turn around each other. By the generated centrifugal force, the crew has the illusion of gravity, because uninterrupted weightlessness would not be good for men over a long period of time. The two first spaceships also serve as recovery cabins. A third spaceship brings metal-gauze, with which a hollow sphere is built near the inertia center of the space-station. Now other spaceships bring building material, and so on, to this metal-gauze sphere. This is stored in this wire cage, so that it cannot float away. Here in this cage we will build electric spaceships and, when they are finished, send them to their respective missions.

On the other celestial bodies, of course, we have no space conditions, also, no Earth conditions. The Moon, for instance, has gravity, but only a sixth of that of the Earth. Air will also be there, but very thin, so that it is impossible to breathe. It will be highly ionized, and it is still dubious whether or not long wave radio communication will be possible in this ionized atmosphere.

The above described space-suit would be too heavy for working on the Moon. We will have to use one like that of pilots at high altitudes for use on our natural satellite.

As an example of other forms and performances of engines that are needed on the Moon, I shall show you here—at request—two slides of a Moon car taken from my book (Slide 3).

The car is held upright by a gyro, that is also an energy-accumulator. The foot of the car can be pulled in and suddenly pushed out, (Slide 4) so that the car is enabled to jump over crevices or rocks.

Now, with this look into the future, perhaps Mr. Barker will discuss our present capabilities.

Mr. C. L. Barker, Jr.

(The next speaker was Mr. C. L. Barker, Jr., Chief of the Astronautical Engineering Section, Army Ballistic Missile Agency, Redstone Arsenal. He was introduced as long experienced in the design of aircraft, rockets and missiles, and currently engaged in the Army orbital carrier and space vehicle programs.

Mr. Barker opened by stating that there have been a total of 7 satellites placed into orbits about the Earth. He said these, with the exception of Sputnik II, which carried the dog, Laika, have contained instrumentation only—primarily for IGY experiments.)

The U.S. satellites have been considerably smaller than those of the Sputnik series. It might be interesting to note that this is not due to any technological breakthrough on the part of the Russians, but to the approach taken toward the satellite problem by the two countries. We, in the U.S., have felt that until certain environmental conditions of space are established, the smaller, more

efficiently packaged satellites would provide a greater flexibility at a lower overall program cost.

In addition to the above mentioned satellites, numerous probes have been sent skyward carrying instruments and animals to study the problems of our upper atmosphere.

From the data obtained from these satellites and probes and from the ones to come, we should be able to safely place man into space for long periods of time.

A portion of our current effort toward placing man into space also includes the high altitude balloon flights, the forthcoming flights of X-15 rocket powered aircraft and the re-entry studies of ballistic missile warheads.

As to what might be possible at the present time, let us consider for a moment the Sputnik III. In this case, a conical payload section, 12 feet long and 5 feet 8 inches in diameter at the base, was placed into orbit. Its weight of 3,000 pounds is adequate for orbiting a man and for his safe recovery after a short flight time—perhaps up to several days.

Mr. Harry O. Ruppe

(The next speaker, Mr. Harry O. Ruppe, is Chief of the Lunar and Interplanetary Flight Unit of the Army Ballistic Missile Agency, Redstone Arsenal.)

Space mechanism is an old science—But as to Astronautics, this is new having its beginning about 1900.

We have basically three interesting areas: first Earth satellites—this means that motion of the vehicle is mainly influenced by Earth gravitational attraction. To counteract this attraction, centrifugal force is used. For producing this force, a high velocity of about 18,000 miles/hr is necessary.

The second area is motion within the Earth-Moon system. Under the influence of two celestial bodies, the Earth and the Moon, very complicated trajectories are possible, and some research must still be done before manned expeditions will venture out there.

Third, we can think of interplanetary flights. But in planetary vicinity, a complicated situation exists.

At least for the time being now, let us forget about interstellar flights.

Vehicles for interplanetary flights may be different from those which connect Earth surface with an Earth satellite. Therefore, at the space-station the interplanetary travelers have to change vehicles. Even if this is not the case, they will refill fuel and oxidizer tanks of their vehicle, since certain complicated missions cannot be accomplished directly from Earth with vehicles which are feasible today. This propellant must be brought to the station as payload of freight-carrying rocket vehicles. So we have the problem—which arises for supply of the manned station, too—of rendezvous between vehicle and spacestation. This is a very difficult technical task. In order to ease it, the station should move in an equatorial plane—the only plane of motion of a satellite, which does not change, and which is convenient for a starting point of an interplanetary expedition. All other planes of motion change because the Earth has an equator bulge of mass.

(Continued on page 30)

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The Flying Saucer Myth

THE Air Force announces that studies it has carried on for more than 11 years have failed to substantiate any claims that sightings of Unidentified Flying Objects are interplanetary visitors or so-called "Flying Saucers." In November 1957 the Air Force reported results of studies of approximately 5,700 reports. On November 6, 1958 the Air Force issued a supplementary report dealing with 1,270 cases investigated during the period July 1, 1957-July 31, 1958. More than 84% of the reported UFO sightings were definitely established as natural phenomena, hoaxes, birds, or man-made objects. Insufficient data was available to thoroughly analyze 14% of these reports, but less than 2% were classified as unknowns.

A sighting is considered unknown when the report contains sufficient information to draw at least one valid conclusion from the facts available but when the description of the reported object or its movements cannot be related to the norm.

The number of cases classified as "unknown" has been consistently reduced from 9% in 1953 to 1.8% during the first six months of this year.

Many UFO reports result from balloons. The Air Force States that 4,000 balloons are released in the United States every day. These are two types, weather balloons and upper-air research balloons, their size varying from 4-feet to 200-feet in diameter. In the case of a balloon caught in the high altitude jet stream, unless the balloon is fully inflated, it may assume a near horizontal position, travelling at speeds of more than 200 miles.

The breakdown of the 1,270 reported cases—July 1, 1957-July 31, 1958, is as follows: balloons 194; aircraft 290; astronomical (bright stars, planets, meteors, comets which due to fog or other conditions have appeared as "unconventional" moving objects) 354; others (hoax,

lights, birds, etc.) 224; insufficient data 187 and unknown 21.

The Air Force considers there will always be a small number of "unknowns," due to high altitude phenomena strange to the untrained eye.

Studies are conducted by the U.S. Air Force Air Defense Command; reviewed by a scientific advisory group at the Air Technical Intelligence Center. Chief scientific consultant to the Air Force on the subject of Unidentified Flying Objects is Dr. J. Allen Hynek, Professor of Astrophysics and Astronomy, Ohio State University.

This is not a visitor from outer space. The Air Force says it is "an artist's conception of a vertical-rising, disc-shaped aircraft which could result from a project under development for the U.S. Air Force" by a Canadian firm.

Dept. of Defense Photo



MAN AND HIS ENVIRONMENT

By CHARLES G. WILBER

Comparative Physiology Branch
Directorate of Medical Research
U. S. Army Chemical Warfare Laboratories

IN all military operations, the environment or surroundings play a key role in affecting the performance of soldiers. We are all familiar with the devastation wrought on Napoleon's army by the Russian environment.

The campaign began in May 1812. The French under Napoleon garnered one victory after another but to no value. The forces of Czar Alexander melted away before the *Grande Armée* of over half a million men. French armies occupied an abandoned Smolensk and took Moscow which shortly burst into flames before their eyes.

Napoleon, cut off from Paris, his rear constantly harassed by Cossacks, and winter upon him, chose to retreat over a land of bitter cold and ice. By December 1812, the Russian environment, plus guerrilla tactics of the invaded people, had reduced the world's finest Army to a handful of sick men in rags. It was the fierceness of the Russian climate and not the might of Russian arms that forced Napoleon to take the critical step toward final destruction and loss of all Europe.

A similar picture presents itself with respect to the German troops on the Eastern front during World War II.

Bitter cold weather, roads that were either a sea of mud or steel-hard ice, plus a dearth of local sources of supplies combined to defeat the invading German army which was composed of first-class troops. It was only the high quality of the men which permitted the German General Rendulic to extricate his army during arctic winter. His feat is one of the most remarkable demonstrations of generalship of World War II. It illustrates the facts that arctic warfare, because of the unique environment, is altogether different from that learned in military academies. It also emphasizes that in the face of such hostile environment "it is man, and not material, that counts."

The peculiar problems which beset the flying soldier are well known to research workers in aviation physiology and medicine.

Man cannot get out of contact with his surroundings. Despite the most strongly worded orders or regulations, individual men respond to environmental variables in a predictable fashion. Motivation will modify responses, but not in a qualitative manner. My purpose in this article is to give a few examples of the influence of the surroundings or environment on man and to propose certain unsolved problems which are worthy of research support by military agencies. The environment can be broken down into the following aspects: (1) temperature, (2) pressure, (3) wind, (4) oxygen, (5) water, (6) light.

Climate has been known for a long time to exert a subtle but very real influence on man. Climate certainly does not change the external appearance of the individual man; e.g., the idea that dwellers in the cold regions of the world are necessarily short, fat and globular in shape whereas those from the warmer climates are skinny and elongated, cannot be supported by sound, factual evidence.

Several interesting studies have been made on the role of seasons and climate on the functional capacities of man; e.g., measurements of oxygen consumption made during different times of the year have shown that during the winter months in a temperate climate the average oxygen consumption of the civilian population increases appreciably. Investigations which were made by the Department of Health in the city of Chicago show that there is a significant increase in deaths from heart trouble during the colder months of the year. The death rate from respiratory diseases is high in the winter but low in the summer; deaths from gastro-intestinal disturbances show the opposite relationship—they are highest in the summer months.

Mills has reported studies on white mice which show that simulated seasons influence the response of this species to disease: e.g., if mice are injected with the organism causing pneumonia, those treated animals which are kept in a very hot room show a much higher mortality rate than similarly treated mice kept in air-conditioned rooms under temperate conditions. The exact explanation for these differences is not clear at the moment. However, studies in global epidemiology show that tuberculosis, leprosy, acute rheumatic fever, and acute nephritis are influenced in their lethality by climate. These facts have led to the general conclusion that "human resistance to infection is highest in the coolness of middle temperate latitudes and is lowest in the warmth of tropical areas."

Man is extremely dependent on an adequate supply of water in order to carry on effectively the many activities demanded of him. In a temperate climate at rest man requires about 2½ quarts of water per day because he loses that much in sweat and through other routes. If the individual's physical activity is increased or if the surrounding temperature goes up, man's water loss through sweating increases also. Therefore, his water intake must be increased. Many people still think that a man can be trained by depriving him of water to reduce his need for water. This is a dangerous fallacy. It must be recalled that man is a simple machine and that his water requirements are merely a matter of arithmetic. If he loses a pint of water by any route whatever, he must

replace that pint of water by drinking or in his food if he is to maintain maximum efficiency. No amount of water deprivation will aid a man in decreasing his water requirements. Such training may be good for his soul, but it will never aid his body. During World War II, on Guadalcanal, water was given the highest priority in the supply system. "The priority of supplies in combat here were: water, ammunition and food. We found that you could fight on an empty stomach, but that you couldn't get to the front without water . . ." Every man was given 2 canteens and they were filled at every opportunity.

The following table gives the amounts of water required per man for troops under temperate conditions. The exact weather data are not included, but the table should give some idea of the minimum water requirements for military operations.

Amounts of Water Required per Man per Day for Troops under Temperate Conditions, Exact Climatic Conditions not Given. (After Wilber, 1957)

Situation	Gallons per Day	Remarks
Combat	1/2 (min)	Absolute minimum for not longer than 3 days. Used for drinking.
Combat	1	Some allowance for cooking and personal hygiene
March or Bivouac	2 (min)	Enough for drinking and cooking, washing of mess and kitchen gear, washing hands and face.
March or Bivouac	5	Should be supplied if possible; will permit some bathing and laundry.
Temporary Camps	5 (min)	Does not include bathing or sewage facilities.
Temporary Camps	15 (min)	Includes bathing

Temperature itself influences man's capacity to per-

form work. As the surrounding temperature increases, the capacity of the individual to perform sustained heavy work is decreased. Increase in physical fitness through training will increase the period of time during which a man can perform heavy work in the heat. However, even in trained men if the temperature is high enough performance is decreased. Whether a similar decrease in mental work is found in the heat is not clear at the moment, but there is some evidence that such is true.

Despite the voluminous records which we have concerning the effect of environment on men, there are many questions left unanswered. Some of the questions which have a definitely military interest are as follows: How does skilled work vary in the heat and in an air-conditioned shop? Is the quality and quantity of mental work modified in the heat? Hand-in-hand with this latter question is the following one: Can men derive maximum benefit from classes held in uncomfortable rooms; e.g., those that are either too hot or too cold? And finally, are there any racial or ethnic variations in response to climate which might be of sufficient magnitude to influence troop selection for specific climatic or geographic areas?

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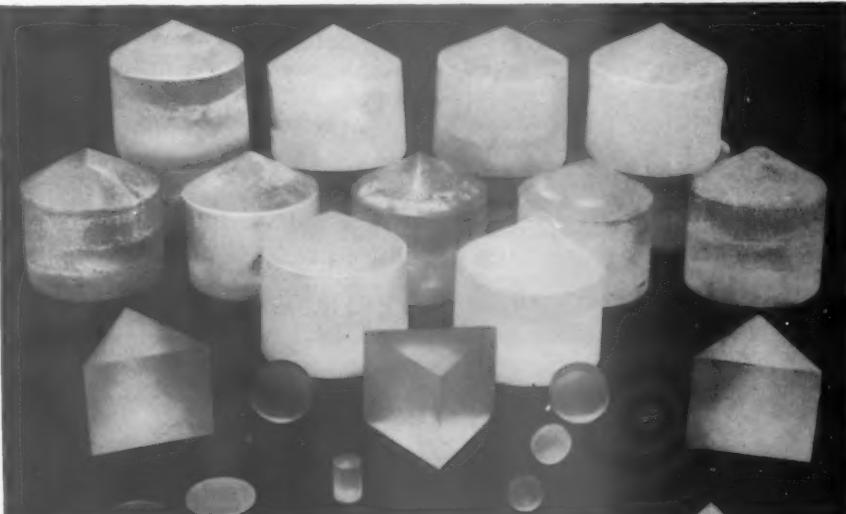
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LOWERING OF BODY TEMPERATURE BY DRUGS

By J. A. LEBLANC

Applied Physiology Branch
Directorate of Medical Research
U. S. Army Chemical Warfare Laboratories

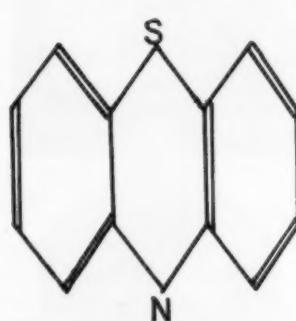
THREE are only a few animals in nature which possess the ability of lowering for long periods of time their body temperature at levels significantly lower than those normally caused by diurnal variations. These animals, which are of course the hibernators, are able to live for weeks on their own body fat reserves without consuming food. This is made possible by a large reduction of food requirements of all tissues since the physicochemical reactions are slowed down at the low cellular temperature prevailing in this state. The energy required for maintaining the vital functions in operation is accordingly reduced since these functions (cardiac, respiratory, renal) are now operating at an "idling" pace. Biologists from all nations have been interested in this eccentricity of nature, so to speak, which we call hibernation. Many important facts are known about this process, but also many questions of primary importance remain unanswered. Indeed no complete answer is available on how hibernation starts, is maintained or ends.

The progress of biologists in this field has been followed with some interest by anesthesiologists and surgeons who had hoped to induce a sort of "artificial hibernation" in humans in the hope of decreasing the danger or risk in some types of surgical operations. In 1950 France offered to the world the recipe for a "lytic cocktail." This mixture according to Laborit was an excellent pre-operative sedative and induced in humans under proper environmental conditions, a state of "artificial hibernation." This "cocktail" contains chlorpromazine (100 mg.), promethazine (50 mg.) and pethidine (100 mg.). The first two ingredients of this mixture are amines derived from phenothiazine as illustrated in figure 1. In a mixture of this nature, although it is true that potentiation or synergism of action exist, it also unfortunately results on occasion that the undesirable or side effects are enhanced. For this reason when hypothermia is in-

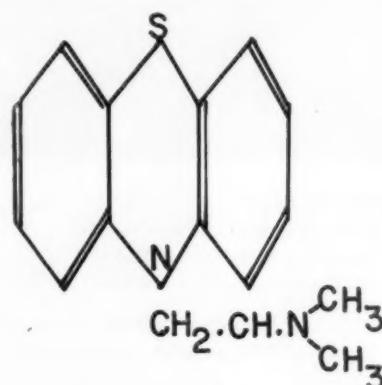
duced in humans, usually chlorpromazine is the only ingredient of this "cocktail" mixture which is used. Of course some narcotic or barbiturate is used in conjunction with chlorpromazine to assure the right depth of anesthesia.

All these drugs put together would not cause much change in body temperature (at least at the therapeutic doses used) unless the environmental conditions were favorable to this hypothermia. Normally chlorpromazine by its tranquilizing effects and because also of the direct depressing effect on the activity of all the tissue of the body, will induce a slight decrease in energy expended or heat production. However, this decreased heat production is too small to cause the drop in body temperature that is desired. The body temperature at which the anesthesiologist maintains the patient during surgical operation is about 9°F lower than normal or in the vicinity of 90°F. Since then the heat production changes induced by chlorpromazine cannot cause this marked drop in body temperature, it becomes obvious that the only alternative is to increase the heat lost. While it is true that chlorpromazine will increase somewhat the heat loss from the extremities, by bringing more blood to the surface, there again this effect is relatively small and could not account for the pronounced hypothermia of this drug. The other alternative, which is in common usage, is to artificially increase the heat lost by physical means. In practice then, the sedated patient is wrapped into a cooling blanket. This blanket, in opposition to its more popular counterpart which has heating elements, contains tubings in which ice-cold water is being circulated. At this point, that is when the subject starts cooling and when normally violent shivering would be experienced, chlorpromazine fulfills its most useful purpose. Indeed by a direct effect on the heat regulating centers this drug blocks the shivering.

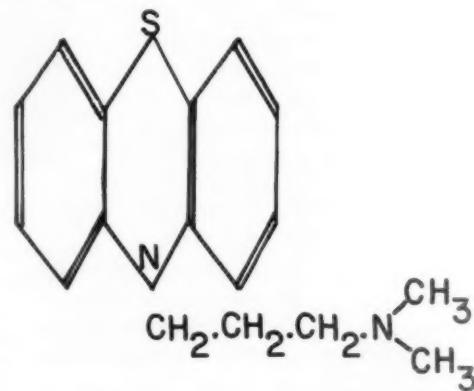
Figure 1: Chemical formula of "tranquilizers" derived from phenothiazine.



PHENOTHIAZINE



PROMETHAZINE
(PHENERGAN^R)



CHLORPROMAZINE
(THORAZINE^R)

The body thermostat, which would activate the heat producing mechanisms as soon as the body starts cooling, remains unoperational. When the surgical operation is finished, the cooling blanket is removed to allow warming up of the body. When the body temperature reaches a certain level, shivering is observed since the chlorpromazine effect has greatly decreased in intensity. However, the sedative effect of this drug is still present as judged by the behavioral attitude of the patient.

In small animals such as rats, which have a very large surface area per unit of body weight, it is possible to induce a very large drop of body temperature in an environment where this animal is normally comfortable. On observing an untreated rat and one injected with chlorpromazine sleeping in a room at 72°F, it is noticed, figure 2, that the normal untreated animal assumes a "ball-shaped" posture, protects its extremities in the fur of the abdomen, and shows some erection of the hair. The chlorpromazine-treated rat lies in a cylinder-shaped posture with the extremities spread away from the body and shows no piloerection. In other words the animal receiving chlorpromazine assumes the posture typical of an animal exposed to a tropical environment when it should assume a posture conducive to heat conservation since the heat production is already somewhat reduced.

Chlorpromazine is also gaining in popularity as a pre-operative as well as post-operative sedative even when hypothermia is not achieved. This drug has received a good deal of attention from research laboratories

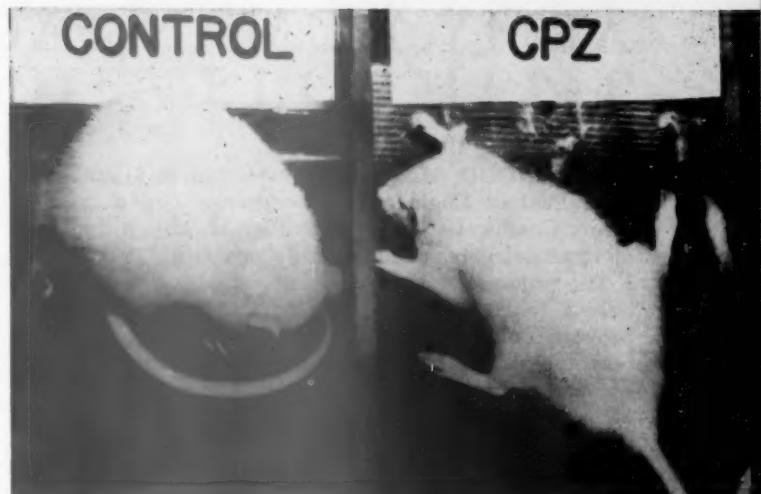


Figure 2: Position of a control and chlorpromazine (10 mg/kg)-treated rat (CPZ) undisturbed in a room at 21°C.

everywhere. However, all its effects and modes of action are far from being completely understood. In spite of this, tranquilizers have become in the last two years some of the most widely used drugs in medicine. This condition is probably due to the fact that only minor undesirable effects are normally observed in the use of tranquilizers.

PARACHUTING FOR SPORT NOW AUTHORIZED BY ARMY

WASHINGTON, (ANS)—The Department of the Army recently announced that its personnel may now participate in properly-planned and supervised "sport parachute jumping," including local, national, and international competitions.

Previously regulations prohibited parachute jumping by Army personnel except in connection with official duties or emergencies.

Amateur parachute jumping has been a recognized sport in Europe for many years. This August the fourth international championship jump was held in Czechoslovakia.

There has been a growing enthusiasm for the sport in the United States as evidenced by the increasing number of parachute clubs being organized under the auspices of the Parachute Club of America.

Newly published AR 95-19 prescribes the safety rules and regulations.

ANTIAIRCRAFT ARTILLERY NOW CALLED AIR DEFENSE ARTILLERY

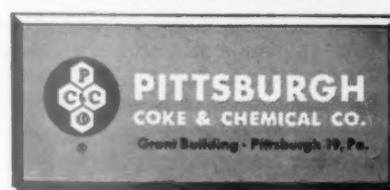
COLORADO SPRINGS, Colo., (ANS)—The Commanding General of the U.S. Army Air Defense Command, Lieutenant General Charles E. Hart, has announced that USARADCOM brigades and groups have been renamed "air defense artillery" units. They were formerly called "antiaircraft artillery."

According to USARADCOM, the change can be marked down as a sign of the times. It emphasizes the shift Army air defense forces have made from antiaircraft guns to the modern, surface-to-air missiles during the last four years.



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ARMY HUMAN FACTORS CONFERENCE

EDGEGOOD, Md.—The Army's fourth annual Human Factors Engineering Conference closed here at Army Chemical Center September 11, after three days of what delegates called "highly profitable" meetings.

The purpose of the gathering, now required at least once a year by newly issued Army regulations, was to provide for an interchange of information between representatives of the soldier in the field and the Technical Services, who keep him fed, moving and fighting.

Some of the nation's leading figures in the fields of psychology and the physical sciences, as well as a number of high-ranking military authorities, were on hand for the sessions, sponsored by Lt. General Arthur G. Trudeau's Army Research and Development Command.

Representatives of industry, allied nations, and the Navy and Air Force also attended the meeting.

Conference keynoter, Lt. General E. T. Williams, deputy commander of the U.S. Continental Army Command, outlined the pattern of warfare of the future to the delegates, challenging them to provide the revolutionary tools of war which will be required.

As the conference progressed, each of the Army's Technical Services briefed the group on the latest developments in its particular area.

ARMY CHEMICAL CENTER, Md.—At Human Factors Engineering Conference here Sept. 9-11, (left to right) Dr. Roger Russell, Executive Secretary, American Psychological Association, and member of the Army Scientific Advisory Panel; Lt. General E. T. Williams, deputy commander, U.S. Continental Army Command (CONARC); Maj. General Marshall Stubbs, Chief Chemical Officer; Maj. General John P. Daley, director of Special Weapons for Army's Research & Development Command; and Brig. General Harold Walmsley, post commander of this host installation.



NEW TRAINING AID FOR FALL-OUT PREDICTION

FORT McCLELLAN, Ala.—An ingenious training aid developed recently at the U.S. Army Chemical Corps School here promises to be highly valuable to both students and instructors for the illustration of fallout prediction concepts.

Commonly called the "Tinkertoy," because of the structural composition, the device is more formally known as the Radioactive Fallout Prediction Model.

It is constructed of vari-colored strips of metals, dowels, and an area "grid" or scale. The model depicts, in time as well as in space, the different predictable routes of fall to the earth of radioactive fallout particles starting at various altitudes.

As the instructor builds the model step by step in class, students are able to visualize the fallout pattern as it develops and to prepare a fallout prediction using given factors, such as wind speeds at specified altitudes, yield of the weapon, and height of burst.

Based on the Army Fallout Prediction Method, the "Tinkertoy" is the "brain-storm" of two School nuclear weapons instructors, Captains Archie Stemper and John McNally. These officers, faced with the problem of illustrating and explaining a three-dimensional problem on a two-dimensional blackboard, started "tinkering" with model ideas in hopes of finding a solution.

Captain McNally, with the advice of Captain Stemper and other radiological warfare instructors, assembled the "X-1 Tinkertoy" out of embroidery thread, coat hanger wire, and hardboard. After minor modifications to the "X-1," a full-scale model was fabricated by the

School's Training Aids Branch. Specifications have also been prepared.

The first use of the "Tinkertoy" in the classroom was during the First Chemical Field Grade Officers' Refresher course in early July. Twenty-six field grade officers attending the four-week course were enthusiastic about the device.

Capt. McNally demonstrates "Tinkertoy."



REVOLUTION IN MATERIALS RESEARCH AND DEVELOPMENT

By LT. COL. J. B. SHIPP, JR., USAF

*Directorate of Research & Development
Headquarters, U. S. Air Force*

THE most sought after scientific answers today are in the area of new materials. Planners and designers, scientists and engineers are voicing the need for new materials; not just improved materials, but radically new and unique materials conceived from new ideas, new discoveries. Throughout the scientific world concerned with flight, materials have become the key to future progress in aeronautics and astronautics. Every-day, both the written and oral word gives evidence of the thermal barrier, the radiation barrier—the materials barrier. To meet the challenge a revolution took place—a new philosophy emerged.

Not so long ago—about fifty years—very little was known about the science of flight. The aircraft industry was in its infancy. Materials of construction, though, were well known; a variety of industries were well advanced. In fact, properties of materials from these older industries far exceeded the requirements. But time passed; the new industry grew, it was exciting and glamorous. And the men involved were visionary and bold. New propulsion systems came along, new aircraft designs, new concepts of flight. Technology advanced rapidly. The industry evolved into one of the largest in the world. And materials, with design compromises, were available.

Then, a few years ago, isolated designers and materials engineers were rather rudely awakened. The rate of materials development had not kept pace! New propulsion systems and new aircraft designs required materials that were not available, nor could it be foreseen that they would be available. Old trial and error methods of alloying, hit or miss chemical synthesis, and design compromise could not satisfy demands. Materials had become the limiting factor in the advancement of flight. This realization, first by a few, and gradually in increasing numbers, was the spark of the revolution in materials research.

Requirements for materials result from environment. As we pursued the goal of faster—farther—higher, a goal which must be attained to survive, the seriousness of the problems could easily be seen. Factors such as aerodynamic heating, high dynamic stresses, nuclear radiation, and prolonged operation at high altitudes and hypersonic speeds demanded materials with properties far exceeding those known. Design compromise could only result in marginal aeronautical progress. Our weapon systems were becoming too complex, our flight vehicles too big and cumbersome, and performance was inadequate. New materials had to be made available which would fully utilize the optimum design to achieve maximum performance.

In order to find answers to the many materials problems, government and industry turned to fundamental research. Realizing that further materials development

was limited; that unless new concepts, new theories, new discoveries were generated, the technical race would not be won, the Air Force channelled increased funds and manpower to the area of exploratory research. Industry too found it necessary to divert a larger and larger percentage of its capital to the research area. New offices, new divisions, new groups were established and staffed to conduct scientific studies. Engineers were looking to the scientists for answers to their problems. This dependence on exploratory research—chemistry, physics, solid state physics—was the fuel for the revolution.

Material Sciences consist of a variety of technical areas, chemistry, physics, solid state physics. Scientists in each area had their own vocabulary, their own special language. Each area was quite large; the amount of research accomplished was considerable; technical publications numbered in the thousands. Because of these individual specialties, and the volume of information available; overall cognizance was extremely difficult. Results in one area could well be the answer to a problem in another area, if it were known. Very often a problem was so basic, so complex, that scientists with different backgrounds, working as a team, were needed to find a solution. The differences in vocabulary, in manner of expression, was very evident in these situations.

Communications—the exchange of technical information—was, and is a problem. To overcome this deficiency, the team concept was established, symposia were held, and many round-table discussions took place. An intermarrying of the sciences—chemistry, physics, solid state physics—together with the philosophy and peculiarities of each, began to take place. This mixing of the sciences, this move toward improved understanding between and coordinated effort by the various doctrines leading to the solution of materials problems was the revolution. It is the philosophy of Material Sciences today.

Within the Air Force there is a program in Material Sciences. This program is an across-the-board program aimed at the solution of Air Force materials problems through exploratory research in chemistry and physics and solid state physics. Each portion of the overall program has its own objectives. Whether these goals be high temperature research, increase in knowledge of the internal structures of the atom, nuclear physics, surface phenomenon, or what, they all are aimed at one common objective—new concepts, new theories, leading to new materials and better utilization of existing materials for Air Force use. Current philosophy—realization of the importance of materials, dependence on exploratory research for answers, and the coordinated effort of the various sciences to provide these answers is meeting the challenge.

DEFENSE CHEMISTRY

By WILLIAM T. READ, SR.



graduate student and instructor (7 years). Research assistant with Arthur Michael of Harvard (1). In 1918 assistant chemist and 1st Lieutenant, Chemical Warfare Service (under Adams and Lewis). Yale (7) Ph.D. 1921; Texas Tech (5), as first head of chemistry department; Rutgers (13), as first, last, and only Dean of their School of Chemistry (now back to Arts and Sciences). Dollar-a-year man under Don Keyes, OPRD; National Roster (3); chemical advisor, Army R and D (11).

Married his first and only graduate student at Texas. Son a physicist, and daughter a physician.

Retired late 1957. One of his present "irons-in-the-fire," this JOURNAL assignment.

FOREWORD

In this first review of chemistry and chemical engineering, a brief word from the reviewer is in order. On 24 September a personal letter and advance copy of the announcement of my appointment to the staff of the Armed Forces Chemical Journal went to thirty members of the staffs of research and development organizations of the Department of Defense, asking assistance in bringing material for this column to the attention of THE JOURNAL. (Since the deadline for copy was "day-before-yesterday," and at the very latest 10 October, material used in this issue was based largely on a backlog of press releases, which contained a surprisingly large amount of sound scientific progress, but items coming directly from the three departments are a richer source of what is sought by THE JOURNAL.) Any material or suggestions for this Department should be referred to the proper official for clearance before it is sent to THE JOURNAL. Grateful acknowledgements are also made here to "Chemical and Engineering News" and "Chemical Week" magazines for interesting items appearing in recent issues.

W.T.R.

Born at Texas A. & M. College, where his father, a Confederate veteran, was the school's first "surgeon." Public schools of Sherman (near Denison, the Eisenhower birthplace). A.B. and A.M. degrees at Austin College (the latter with English as a major, the chemistry professor away at Heidelberg); between degrees two years as kid editor of Lampasas Daily Leader. University of Texas;

BASIC RESEARCH

In the field of silicon compounds, basic research carried on at Wright Air Development Center has resulted in some very unusual and promising compounds belonging to the general class of silanes. These are remarkable in that four aromatic hydrocarbon radicals are directly linked to one silicon atom. The simplest of these "perarylated silanes" has the formula, $(C_6H_5)_2Si$. Only a few have been made, but the feasibility of the reaction has been demonstrated, and pilot-plant operations have resulted in multi-pound quantities of these products. These silanes have remarkable heat and radiation stabilities. Tetraphenyl silane boils at 430°C, which indicates that these may function as insulators and dielectrics. They have possibilities of polymerization to yield a new type of plastics. The unusual reactions by which silanes are made can probably lead to a very large number of highly desirable properties. The results of these developments are being watched with great interest, both by industry and the Department of Defense. This is an outstanding example of the way in which basic research pays off.

PLASTICS

Silicone resins of high thermal stability have been prepared for the Air Force. Some of these materials are thermosetting, and function as laminating resins and structural adhesives. These materials are made with aromatic hydrocarbons as well as the aliphatic radicals more common in silicones. Unlike the silanes reported above, these materials contain elements other than carbon, hydrogen and silicon, including oxygen and chlorine.

SYNTHETIC RUBBERS

Silicon appears in elastomers that are high-temperature and aircraft-fuel-resistant materials, these being derived from monomers containing aliphatic radicals and chlorine attached to silicon. Oxysilanes are being copolymerized with these silanes with potassium hydroxide as a catalyst.

A linear copolymer of vinylidene fluoride and hexafluoropropylene containing 65% fluorine is being made in a full-scale pilot plant, and competes with other specialty rubbers, particularly silicones and trichlorofluoroethylene. The material is white and translucent, and resists oxygen, ozone, solvents, acids, and alkalies. Before vulcanization it dissolves in ketones to produce cements. The greatest outlet of this material is in aircraft seals in military planes, but many nonmilitary applications are foreseen.

A nonadhering polyurethane has been developed for the Air Force as a cushioning material for packaging operations. Machines are in use to foam-in-place these

materials with accompanying reduction in costs and increased flexibility of operation. Organic acids of the fatty type function as release agents to free the foam from glass and metal surfaces.

Polyisopropyl styrene is converted to the corresponding hydroperoxide, which serves as an initiator for production of polymers of the graft type. Seven out of one hundred isopropylstyrene groups are converted to the hydroperoxide.

After the announcement a few years ago of the successful polymerization of isoprene, the basic unit of natural rubber, to produce a synthetic rubber equal to the natural product, exhaustive tests of the commercial product have been awaited with great interest. Such tests have been reported by the Quartermaster Corps, which prove that it is equal, and in some cases better than natural rubber for many purposes. Heretofore the difficulty of duplicating natural rubber by polymerization of isoprene has been the attainment of material having the "cis" configuration, or molecules in which the methyl groups are all on the same side of the nonrotating double bonds. A mixture of cis and trans isomers is distinctly inferior. The success of the process depends largely on the use of an alkali metal as a catalyst. Other synthetic rubbers develop excessive heat in heavy tires in hot weather, so that natural rubber has been required for making truck tires that are on vehicles driven at relatively high speeds.

FUELS AND LUBRICANTS

Two phases in the field of motor fuels, particularly aviation gasoline, are the production of these materials in every possible way, and the storage of the more volatile products over long periods without loss or deterioration. Low temperatures are ideal for the second purpose, but refrigeration in ordinary climates is as expensive as the fuel. The Arctic Icecap has been found ideal as a location for cold storage, preventing both evaporation and the development of impurities by chemical action within the liquid itself. Pits carved in the ice in tunnels appear to be an ideal answer to this problem.

Motor vehicles depend on the addition of the negative catalyst or antiknock, tetraethyl lead, to give gasoline its maximum efficiency. The common method of making this material is to react ethyl chloride with an alloy of sodium and lead. A better method is now being employed which involves the use of aluminum acetate, cadmium acetate, and ethyl iodide. In the older process only 25% of the lead in the alloy is available for the reaction, the remainder being recycled.

Two sources of raw material for supplementing present supplies of petroleum are oil shale and gilsonite, a natural bitumen. The former source, whose present use is limited by processing, may be the answer to the shutting off of supplies of cheap oil from the Middle East. Gilsonite is found in Utah and Colorado, where petroleum must be brought in from distant sources. The supply of gilsonite is abundant; the finely ground material is pumped by fluidizing techniques; and a refining company is producing from it a good grade of gasoline, as well as processing the raw material into waterproofing coatings, varnishes, battery boxes, and insulation.

Special lubricants are now being synthesized by a variety of methods, which either have no direct connection with petroleum or a remote relation through petrochemicals. Among the new types of compounds that function as lubricants are the following. Ferrocene, which is a cyclopentadienyl, forms metallic derivatives that have exceptional thermal stability, which make

them useful for extreme temperature lubricants and hydraulic fluids. Other ferrocene derivatives include aryl, benzyl, and silyl compounds. Silicate esters of sebacic acids have proved to be efficient lubricants for jet engines. One pint is sufficient for four hours flight in contrast with a gallon an hour of ordinary hydrocarbon lubes. Pentaerithyl esters also have high thermal stability.

Hydrocarbon-air-mixtures containing film-forming agents permit frictionless-bearing lubrication, allowing ball and roller bearings to operate up to 1,000°F without the use of oils or greases. Aircraft jet fuels furnish the hydrocarbons required. Tests conducted at 10,000 rpm over a range between 100°F and 900°F with bearings of tool steel proved entirely successful. This technique is the closest approach to "floating-on-air" ever attained in the field of aircraft lubrication.

FOODS

At a conference sponsored jointly by the American Institute of Chemical Engineers and the American Society of Mechanical Engineers, a report was made covering successful methods of evaporating milk to one fourth of its bulk and freezing the concentrate, so that after a year of storage reconstitution resulted in a product that could not be distinguished from whole fresh milk.

The Quartermaster Corps has developed a new type of dry mix containing chemical leavening agents and flavoring materials instead of the conventional fermentation processes, from which fresh bread can be made and supplied to armies in the field with great reduction in preparation time. A 50-ton bakery, operated by 250 men, can feed 100,000 men when operated 24 hours per day. Canned bread requires an equal weight of metal in the containers, and is around 35% water.

Meats can be dehydrated and shipped without loss of essential vitamins. Even on six months of storage, retention of riboflavin and niacin is good, and only thiamine shows considerable loss. When used in a short time after dehydrating and shipping, the meats are easy to prepare, have high nutritional density, and no loss of riboflavin, niacin, and thiamine. Nondehydrated canned meats show the same loss of thiamine as dehydrated material stored for long periods.

Radiation sterilization of foods is of particular interest to the Quartermaster Corps, and has been heavily supported for some years. Recent tests on four generations of laboratory animals totalling 1,600 in all, half of which received irradiated foods and the other untreated foods have shown no changes from normal. Beef, pork, bacon, fresh vegetables, fruits, powdered milk, and military cereal bars were among the irradiated foods tested.

BIOCHEMICAL ADVANCES

Aditives have been found to in-

crease the efficiency of antibiotics and vitamins. Glucosamine is said to double the absorption in the blood stream of tetracycline in two hours without irritation of the stomach or causing allergies. Sorbitol increases absorption of vitamins and other nutritional agents. This valuable discovery was more or less accidental, since sorbitol had been used as a harmless carbohydrate binder of radioactive Vitamin B₁₂.

Disease-bearing bacteria thrive under conditions of high humidity, while they are killed rapidly by bright sunlight. This discovery has military implications both in offense in choosing times of attack, and in defense in increasing precautions against such agents. It also has many civilian applications in added protection against infections.

(Continued on page 21)

AIR POLLUTION

CONFERENCE SPONSORED BY

PUBLIC HEALTH SERVICE

CHEMISTS and chemical engineers will have leading roles in the National Air Pollution Conference, to be held November 18-20 at the Sheraton-Park Hotel in Washington, D.C.

The interdisciplinary meeting has been called by Dr. Leroy E. Burney, Surgeon General, Public Health Service, U.S. Department of Health, Education and Welfare, to enable air pollution specialists and civic and industrial leaders to review recent knowledge about the air pollution problem and to recommend plans for dealing with it.

As President of the Air Pollution Control Association, Lt. Colonel Arnold Arch, Chemical Corps reserve officer, now retired, will make the responding address at the dinner meeting scheduled for the second evening of the Conference.

An alumnus of Massachusetts Institute of Technology, with graduate work in chemistry at Harvard, Colonel Arch served during World War II in the 91st Chemical Mortar Battalion, European Theatre, and was awarded a Bronze Star Medal in 1945. He currently is Director of the Air Pollution Control District, of the City of Niagara Falls, N.Y.

Among the chairmen and co-chairmen of the six discussion sessions which will feature the second day of the Conference are Dr. H. C. McKee, chemical engineer at Southwest Research Institute (Extent of Air Pollution);

and Arthur Crago, manager of the Florida plant of American Cyanamid (Economic Effects). Subjects for the other three discussion panels will be Sources of Air Pollution, Health Effects, Control Methods and Procedures, and Administrative Aspects.

Surgeon General Burney will present a "status report" on the progress to date of the five-year program of research and technical assistance to States on air pollution problems which was authorized by Congress in 1955. This will include a report on the National Air Sampling Network, which has been set up in cooperation with the States and communities. (See project map herein.)

The Sampling Network is the first attempt to collect and analyze air pollution data on a nation-wide basis. It already covers 112 urban sites and 45 others outside of cities, where samples are collected for analysis at the Public Health Service's Sanitary Engineering Center at Cincinnati.

Among the other speakers scheduled is U.S. Senator Thomas H. Kuchel, of California, father of the Air Pollution Control Act, who will talk on "The Public Interest." Representing the American Association for the Advancement of Science will be Dr. Chauncey D. Leake, of Ohio State University, who is to address the Conference on "Social Aspects of Air Pollution."



DEFENSE CHEMISTRY

(Continued from page 19)

PERSONNEL PROTECTION

of counting cells making up aerosol particles, but does not determine the size and count of viable particles in air. Capacity of pathogenic agents depend on these two factors. The new Andersen sampler has been announced by the Chemical Corps which collects and identifies pathogens, and automatically separates them into size categories. It has already proved useful in public health and industrial hygiene, and applications are foreseen in detecting disease-bearing organisms in hospitals, schools, and in public places generally.

Simple types of apparatus have been developed for removing toxic materials from measured volumes of air through impingement on activated material, a bed of sensitized material in a small glass tube, and mechanical filtration and adsorption. Typical detection and estimation methods are those for lead dusts, arsine, hydrogen fluoride, hydrogen sulfide, mercury vapor, hydrogen cyanide, sulfur dioxide, carbon monoxide, and aromatic hydrocarbons.

A new chemotherapeutic agent known as Betaprone gives promise of eliminating hepatitis in blood transfusion, and will also sterilize blood vessels, bones, and cartilage employed in repair types of surgery. Seven years of test have resulted in preventing hepatitis in patients in one hospital who received plasma transfusions.

Gaseous ozone is proving effective in sterilizing sewage and other contaminated liquid wastes. The gas is generated by silent electrical discharge, and is bubbled through tall columns down which the sewage flows. Ozone has long been used in treating potable waters, but this is an attempt to effect complete sterilization of complex wastes. Nuclear radiation and the heat from submerged combustion or from nuclear reactors are being considered as future possibilities for the same purpose.

METALS

METALS liable and efficient for aircraft hydraulic system applications at temperatures up to 1,000°F. The eutectic alloy of sodium and potassium has proved the best of all metals tested. It functions well with most materials, particularly low-carbon stainless steels. Carbide and boride base cermets are promising bearing materials.

Very fine grained nickel surfaces are produced by plating on a surface carrying a very thin layer of graphite or nickel powder, bonded with resin powder. The nickel tends to duplicate in its crystal structure the size of the microscopic grains below it. A preliminary flash plating of copper is required. The surface so produced has exceptionally high abrasion resistance, and bending of plated sheets produces no surface cracking. Base metal so plated is competitive with stainless steel.

A very thin metal film of various types is proving to be sensitive, easily inspected, and economical corrosion indicator, being of particular value in connection with corrosion by adsorbed gas. When small particles of oxide of iron form on a surface, they become elements of electrolytic cells and cause electrochemical destructive oxidation.

NUCLEAR CHEMISTRY

terest entirely apart from weaponry have been recently announced. Radioactive material in an ionization chamber puts an electrical charge on extremely small particles

Several applications of nuclear energy of military in-

in suspension in air or other gases, by means of which elements and compounds can be detected and their concentrations measured in terms of "parts per billion." If the material is a gas, it must be converted to a solid compound, as for example ammonia to ammonium chloride. The instrument by which these tests are made functions not only in determining atmospheric pollution by industries, toxic gases in chemical process streams, and dangerous materials in plants, but will give warnings of war agents. If the agent is a gas, it will be necessary to draw the sample through another gas that will convert the toxic material to an aerosol.

Charged metallic particles of aerosol dimensions are driven at terrific speeds in a linear accelerator into the lattice structure of another metal to produce alloys that are impossible to make by any other method. For example, aluminum boils at 3,740°F and iridium is only melted at 4,450°F, so that it is impossible to make an alloy of these two metals. Results of this new procedure are sufficiently promising that it is expected to yield alloys of new types, to produce polymers such as silico-halides which cannot be made by present methods, to obtain a perfect vacuum for laboratory studies, and to study missile "skins" subjected to solid-particle bombardment in outer space.

Blood volumes are being determined by the use of harmless radioactive isotopes such as sodium chromate-tagged cells. This permits accurate determination of blood-volume fluctuations following ingestions of food and fluids; administration of the blood-volume expander, Dextran; the effect of removal of considerable quantities of blood; and the phenomena of vasodilation and vasoconstriction.

Radiation is already assuming considerable importance in the field of chemical processes. This is particularly true in the vulcanization of certain synthetic rubbers. Long-lived substances such as cobalt-60 produce effects in the cold that are not as well attained by the ordinary hot methods. Nitrogen fixation is accomplished at temperatures around 200°C that require $3,500^{\circ}\text{C}$ in the arc process, the ultimate product, being in both cases nitrogen dioxide, NO_2 . Some nitrous oxide, N_2O , is made at the same time.

One of the possibilities in the application of nuclear energy is that it may solve the problem of potable and industrial water supplies obtained by the distillation of brackish or sea water. As fossil fuels become scarcer and the technology of nuclear engineering becomes more advanced, the costs of distillation by nuclear and fuel energy may become sufficiently close so that in regions where transportation of fuels is a problem it may prove practicable to employ the heat of fission reactions.

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THE ARMY AT HOME AND ABROAD

GENERAL MAXWELL D. TAYLOR

Chief of Staff, United States Army

(Condensed from an address before the U. S. Conference of Mayors, Hotel Fontainebleau, Miami Beach, Florida, September 13, 1958)

AS I travel about the country in the course of my duties, I often feel that the purposes and objectives of the Armed Services are often not clearly understood. I remember that when I returned as a cadet from West Point to visit my grandfather, a Civil War veteran, he posed the question which I am sure many citizens ask today. "Son, when there's nobody to fight, why do you drill so much?" Well, the reply takes a little time and unfortunately many citizens do not have the time to listen. This problem of explanation is intensified by the diversionary effect of the great public interest in man's pioneering exploits in space, in operations under the polar ice-cap, and the other displays of the striking technological progress of our age. These brilliant successes by their nature tend to obscure some of the basic problems of our national defense, particularly those which revolve around the military control of the earth's land surface—which is the area of primary interest and responsibility of the Army.

A large organization like the Army has many personalities which create different impressions, depending upon the viewpoint of the observer. In one of its aspects the Army is an aggregate of uniformed individuals coming from every walk of American life. At home, they are in every state and territory of our Nation. Abroad, they are scattered in over 70 countries where they represent in foreign eyes the qualities and attributes of the American people.

But in its most fundamental aspect, the Army is not an aggregate of individuals but first and foremost a powerful fighting team, standing with its sister Services as a shield of deterrence against war, large or small. But even this concept of the fighting team is not complete because the Army must maintain behind the fighting front which it presents to the enemy, a great worldwide business organization with capital assets of real estate, supplies, equipment, and various holdings to the value of over 50 billion dollars. In terms of the business district, the Army is a company which must meet a payroll of nearly 1,300,000 men and women. Because of this diversity of its aspects and its activities, the Army must include not only tough soldiers for the battlefield but technicians and scientists for the laboratories, logicians for its dealing with industry, and countless other skills all required to maintain and support a modern Army.

To give you some picture of the activities, I propose to conduct a brief travelogue to some of the areas where the Army is at work.

Let us start this travelogue in the Far East. First, look in upon Korea where some 50,000 of our Army troops are still engaged in the defense of a very important strategic area. The Korean front no longer attracts the big headlines, but it is still there—140 miles of fortifications along which our Army and its South Korean allies face a heavily armed Communist force of over 400,000 men. The endless nature of our task in Korea suggests the endlessness of the responsibilities of leadership which our Nation has assumed world-wide.

But the Army in Korea has done more than man a fortified front. Throughout the countryside we can find

examples of assistance given by our servicemen to the rehabilitation of South Korea. On all sides there are schools, churches, hospitals, irrigation systems, bridges, and roads which are the product of the so-called Armed Forces Aid to Korea Program, which grew out of the instinctive desire of our American fighting men to alleviate the ravages of war in the country where they serve. Also in this rear area, we can see the work of our Military Assistance Advisory Group engaged in building and training the South Korean Army. Thanks to American efforts, the South Korean Army is the fifth strongest army in the world today and a formidable force for democracy in the Far East.

If we visit Japan we will note that the Army is phasing out many of its activities, but continues to maintain supply facilities necessary to support any recurrence of military activity in the Far East. One important residual activity is the military training mission to assist the Japanese in further developing their own defensive strength. On Okinawa, as in Korea, we find elements of the Army working to improve the economy of that island.

Moving southward to Taiwan, we find members of another Military Assistance Advisory Group advising and training the Chinese Nationalist forces. In this connection, I might add that Army members of this group have been and still are on the shell-battered island of Quemoy, assisting and advising Nationalist forces as part of United States support of its ally in the face of renewed Communist Chinese aggression. Similarly, in the Philippines and in Viet-Nam, there are Army forces preoccupied with the development of native forces capable of deterring Communist aggression against their homelands.

As we continue our travels, we overfly military missions in Thailand, Pakistan and Iran, then arrive in the troubled Middle East. The recent events in Lebanon, Jordan, and Iraq are still fresh in our minds. While the restoration of normal relations in this part of the world is not yet accomplished, the rapid intervention of our forces in Lebanon has brought a measure of stability to an area threatened by chaos. The effective teamwork between Army, Navy, Air Force and Marines in the swift execution of this military operation exemplifies the prompt reaction which the United States must be prepared to make to counter aggression anywhere anytime.

Continuing on our way, we arrive in Western Europe where the principal strength of the Army overseas is deployed. Here, the United States Seventh Army is a powerful component element of the NATO defense structure. Also, in most of these NATO countries, there are Army missions helping to give these countries an improved capability to defend themselves. We never lose sight of the fact that security must be truly mutual.

Now, before we return to the United States, let us sum up the meaning of what we have seen in our flying trip abroad. What is the Army doing overseas in the course of discharging its varied missions? First and foremost, it is being a deterrent force—contributing to the prevention of war. As an additional deterrent, we are

creating local strength through training local forces, often in areas where only weakness existed before as an invitation to an aggressor.

The aggregate strength of indigenous and U.S. forces in vital, strategic areas, such as Western Europe, must be sufficient to provide a strong, forward shield capable of repelling a surprise or deliberate attack. Trip-wire or token forces for this vital ground mission will not do. They are needed in significant strength to prevent a forward surge by hostile land forces seeking safety from our atomic weapons by grappling quickly with our defensive units. Shield forces are needed to keep the battlefield forward and outside the friendly lands which we are charged to protect. They must be strong enough in defense to gain for us the reaction time needed to ready our retaliatory blows. Finally, the American forces in this shield have the added importance of presenting proof to our allies that we are willing to share with them the day-to-day hazards of living under the Communist guns.

After this trip abroad, let us take a look at the Army at home. Here we have three major functions: First, is the maintenance of mobile, combat-ready, strategic Army forces prepared for rapid deployment to any point on the globe to deter aggression or prevent its spread into general war. Next is our contribution to the air defenses of the United States. And, thirdly, the Army must maintain and operate a large training and logistic base.

With respect to the first of these major functions, you may have noted the recently announced existence of the Strategic Army Corps, known as STRAC, consisting of many of the combat units in the United States. STRAC represents a spearhead of versatile military power which, with the support of the Air Force and Navy, is ready for prompt delivery to those areas of the world where U.S. interests may be threatened. To those of you coming from the major cities of our country, the Army's role in continental air defense is perhaps better known than to others. We believe that in our surface-to-air missile defense systems, the Army provides weapons, which in conjunction with those of the other Services, will cause any prospective enemy to give serious pause before launching an air attack against us.

The Army has been a pioneer in the development of surface-to-air and surface-to-surface missiles. In the former field, we initiated the development of the NIKE AJAX in 1945 and made it operational in 1953. It has been a natural transition for the Army to move from conventional antiaircraft artillery to surface-to-air missiles. As military aircraft flew higher and faster, our responsibility for shooting them down remained unchanged but the task became technically much more difficult. It became clear that the missile was eventually the only response to this growing bomber threat.

Thus far, we have been able to anticipate the progressive improvement of bomber aircraft and have kept pace with it. The NIKE AJAX is an excellent weapon against the aircraft for which it was designed. But it was necessary to anticipate the development of supersonic aircraft flying at very high altitudes and to be ready with a second generation NIKE—the HERCULES. This weapon is capable of firing either a vastly improved conventional warhead or of utilizing an atomic warhead. It is a highly effective missile which can knock down any aircraft that flies today or that we can foresee in the next few years. Its reliability has been demonstrated many times. The accuracy of the HERCULES will permit the safe firing of its atomic warhead over inhabited areas and will also enable it to destroy with conventional high explosive

high speed jet bombers singly or in formation.

The third major activity of the Army at home—training—remains, as always, one of our principal functions. A major problem continues to be the very high rate of turnover in our personnel—over 30 percent in Fiscal Year 1958. However, we expect this condition to continue to improve with time. We are taking vigorous action within our resources to provide for improved conditions of service to assist in reducing the high turnover rate.

In this connection, I am often asked if I can foresee the end of the need for Selective Service. Frankly, I cannot. As long as the Armed Forces require something like two and one-half million men in the three Services, there is no basis in past experience to believe that these manpower requirements can be met without Selective Service. Although the Army is presently the only Service receiving inductees, all of the Services benefit from the Selective Service Act. All of us receive a large, though indeterminate number of men whose volunteering is motivated by the presence of the draft law. I might add that the Selective Service law brings to the Army some of our very best soldiers.

Not only do we train recruits, but we run the schools at all levels. In Fiscal Year 1958 Army-conducted schools taught some 700 courses, graduating over 150,000 students, including foreign military personnel from 62 nations. With respect to the training of foreign students, the United States gains important collateral benefits from their attendance in our schools. Having lived with us over an extended period, in most cases, these students return to their specific countries devoted to our system of life and government.

At the outset, I mentioned the business activities in which the Army is engaged as a part of the logistical operations related to its support of our current worldwide commitments. In some 40 Army-owned industrial activities and 60 facilities in the United States we manufacture, store, process, distribute, and rehabilitate some 20 billion dollars worth of equipment and supplies. In general, the Army produces little for itself in its plants and arsenals but looks to American industry for most of its hardware. In the last fiscal year, the Army placed over 1.8 million contracts with private industry, totaling more than 5 billions of dollars for goods and services. Throughout the country, over 3,100 research contracts were placed in laboratories and similar enterprises valued at more than \$660 million. From this research and development effort will come the weapons and equipment to meet the challenging requirements of future warfare.

A familiar element of the Army in our communities is the citizen reserve—the Army National Guard and the U.S. Army Reserve. These important components of our military strength provide the mobilization backup for the active Army.

Both the National Guard and the Army Reserve stand at an important turning point in their development, as they confront the requirement to reorganize their units in consistence with the requirements of modern warfare. The Regular Army preceded them in the change of our divisions to the so-called pentomic structure. I am thoroughly aware that this requirement to reorganize presents serious problems to our reserve components and has created unhappiness, particularly in the National Guard. I assure you, that this reorganization plan is not a whim of the so-called brass in the Pentagon, but is a hard inescapable requirement for the effective use of Army forces in time of war.

(Continued on page 29)

CHAPTERS IN CHEMICAL WARFARE

VI

THE HISTORY OF DR. BRAND'S PHOSPHORUS ELEMENTARIS

By WYNDHAM MILES

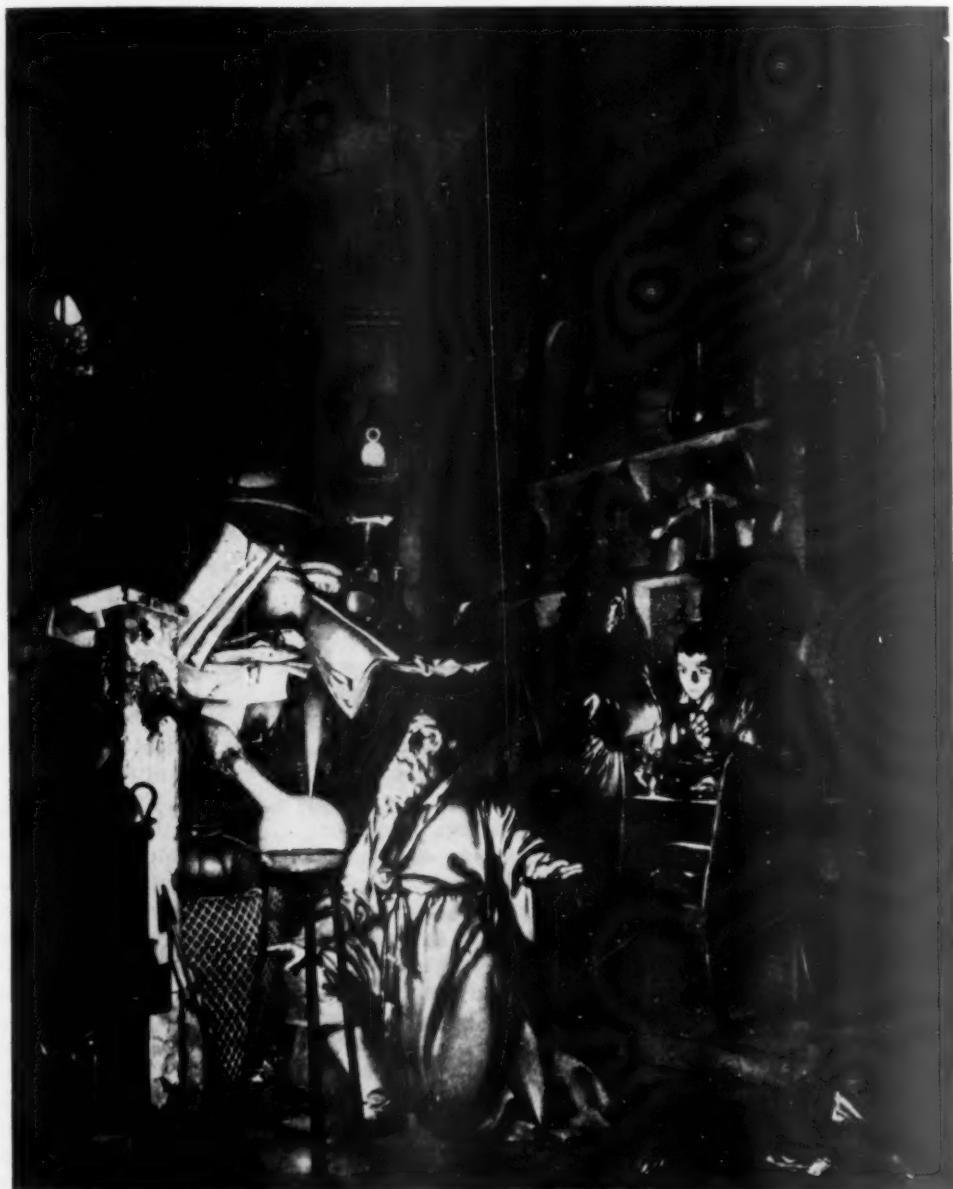
U. S. Army Chemical Corps Historical Office

— CORRECTION —

The article by Dr. Miles about James Cutbush's "System of Pyrotechny" in our September-October issue was erroneously listed as No. IV in this series. It should have been listed as No. V.

Another interesting article will appear as Chapter VII in an early issue.

"The Discovery of Phosphorus" by the English painter, Joseph Wright (1734-97), one of the most famous alchemical paintings of the eighteenth century.



IN accounts of early seiges, battles, and campaigns we occasionally run across the mention of incendiary munitions. The Romans filled pots with pitch, sulfur, and other flammable substances, ignited them, and then threw them at enemy buildings or ships. In the seventh century the Byzantines came up with Greek Fire, the most famous of the ancient incendiary mixtures, containing sulfur, petroleum, gums and resins. Later came fire rain, fire balls, fire flasks, inflammable darts, inflammable balls, and other incendiaries with odd-sounding names, containing sulfur, gunpowder, saltpetre, and other pyrotechnic materials. Once in a while the crude incendiaries of olden times set fire to a ship or a city or a castle, but generally they were unreliable and they caused little or no damage.

When we examine the list of materials that went into early incendiaries we find that phosphorus is absent. Why, we may ask, did ordnance experts not use this substance? It catches fire spontaneously in air, and this circumstance would have eased the task of artificers in devising reliable munitions. The answer to that question lies in these facts: phosphorus was not isolated until 1669, phosphorus was so difficult to obtain that it remained a curiosity for a century, and after phosphorus became commercially available conservatism on the part of military authorities kept it out of munitions for another hundred years.

The history of phosphorus began in 1669 at Hamburg, Germany, with an impoverished merchant named Henning Brand trying to regain his wealth by making alchemical gold. During the course of one of his outlandish experiments Brand evaporated a large quantity of urine, heated the residue with water, filtered it, evaporated the filtrate, added impure sodium sulfate and weak alcohol to the residue, and then heated the mixture in the hottest fire that he could make. By luck the conditions were just right for the reduction of the phosphate in the residue to phosphorus. Alchemist Brand must have been an astonished man when he beheld the new element and saw how it burned in air and glowed in the dark.

While Brand did not find the gold he was seeking, his discovery brought him gold indirectly. Other men showed so much interest in the marvelous substance, called Phosphorus Mirabilis, Phosphorus Igneus, Brand's Phosphorus, Lumen Constans, and a number of other names, that Brand was able to sell his recipe. He and the buyers tried to keep the process a secret, which they succeeded in doing for a time, but European chemists were too curious to let the matter rest and within a few decades the method of preparation became public knowledge.

For the next hundred years chemists continued to obtain phosphorus from urine. Then around 1770 two Swedish chemists, Johann Gottlieb Gahn and Karl Wilhelm Scheele, found that phosphorus could be obtained more easily from bones. Calcium phosphate, present in bone ash, could be converted to phosphoric acid by means of sulfuric acid, and the phosphoric acid then reduced to phosphorus by heating with carbon. This was a much simpler process, and it lowered the price of phosphorus. For a third of a century there was little change in the phosphorus industry. Then in the 1800's an additional source of phosphorus was discovered in phosphate rock, a natural form of calcium phosphate found in large deposits. Phosphate rock was a cheaper raw material than animal bones, and manufacturers were able to drop the price of phosphorus further.

The idea of using phosphorus in munitions seems to have first cropped up in the 19th Century. During the Napoleonic wars, chemist Frederick Accum tried to de-

velop a phosphorus incendiary shell for the British Navy to use against Napoleon's invasion fleet. After Napoleon cancelled the invasion, British military authorities lost interest in Accum's shell, and the would-be inventor turned to other projects.

The Crimean War in the 1850's stimulated the minds of inventors to propose more and better phosphorus-filled shells. Lyon Playfair tried to persuade the British War Office to employ a shell containing phosphorus dissolved in carbon disulfide against Russian installations. Henry Disney applied for a patent on an incendiary shell which, from contemporary accounts, contained a solution of phosphorus. John Macintosh received Patent No. 1774 in 1855 for incendiary devices, including shells filled with "coal-tar naphtha mixed with phosphorus and bisulphuret of carbon, with bursting powder sufficient to open the shells." But the British high command brushed aside these ideas and fought the war with conventional shot and shell.

The American Civil War saw more incendiary activity than any war up to that time. The North purchased incendiary shells from Robert Fleming, Levi Short, and Alferd Berney, and used them on various occasions. The shells, on the whole, were a failure, but a few fired from the Swamp Angel into Charleston in the early morning hours of August 22, 1863, started fires within the city. Daring Southern spies employed incendiary sabotage devices to burn Federal transports on the Mississippi River, and to set fire to buildings in New York. Jeb Stuart's outfit on one occasion fired Congreve rockets filled with "liquid damnation" against McClellan's encampment at Harrison's Landing. The records are not always complete as to the design of Civil War incendiaries since inventors tried to keep the composition of their incendiary mixtures secret, but all evidence points to the presence of phosphorus in the fillings.

The modern method for the production of phosphorus dates from the 1880's when English chemists began to develop an electrothermal process in which phosphate rock, sand and coke were heated in a furnace by passage of an electric current. This process had the advantage of being continuous, whereas the old process was carried out in batches. It was considerably cheaper, particularly in areas where hydroelectric plants were located. The first American electrothermal phosphorus was produced by Oldbury Electrochemical Company at Niagara Falls in 1896.

By the early 1900's the price of phosphorus was the lowest it had ever been, but the demand for phosphorus was limited. Most of it went into compounds such as sesquisulfide for matches, oxychloride for dyes, and phosphites for medicine. At the start of World War I the total American output amounted to only 1,300,000 pounds a year, selling at about \$1.00 a pound, produced almost exclusively by Oldbury. Then the British Army began using phosphorus in munitions as a smoke, incendiary and anti-personnel agent, and the demand for the element shot up. After the war additional uses for phosphorus kept the industry expanding. By 1930 U.S. plants turned out 21 million pounds a year; by 1940, 97 million pounds; by 1945, 160 million pounds; and by 1950, 307 million pounds.

Today phosphorus, which sold for \$250 an ounce in Brand's time, sells for less than 20c a pound. Modern incendiaries such as napalm are so effective that phosphorus is no longer considered primarily for that purpose, but it remains among military chemicals because of its ability to produce smoke, a use undreamed of by our forefathers.

THE MANUFACTURE OF MUSTARD GAS IN WORLD WAR I

By JAMES K. SENIOR

Department of Chemistry
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Chicago, Illinois

EDITOR'S NOTE—This is the second and concluding installment of the article by Dr. Senior relating his extensive observations and experiences in respect to the manufacture of mustard gas by the Allies in World War I.

The first installment, published in the September-October issue of *THE JOURNAL*, dealt initially with technological problems faced by the Allies in attempting to develop quickly a satisfactory process for large-scale production of mustard gas, despite the fact that suitable laboratory methods for making it on a small-scale had been known for many years. This was followed by an account of his visits to French manufacturing plants. Dr. Senior was then a First Lieutenant in the Chemical Warfare Service, stationed at Headquarters, American Expeditionary Forces, in Paris. He described as "astonishing" some of the plant equipment, including massive solid silver parts which he observed, but praised the French for going ahead with manufacture without waiting for a fully satisfactory process.

This installment presents Dr. Senior's account of his observations in the United Kingdom followed by his return then to the United States, and concludes with a narration of his experiences and views pertaining to the mustard gas production activities in this country.

In the author's note accompanying the first installment Dr. Senior explained that this article is adapted from a paper delivered by him at a meeting of a club in Cincinnati, his native city, during the winter of 1921-22. Laid away and forgotten for over 35 years, the paper came to his attention in going through effects in preparing for a change of residence. Dr. Senior recently retired as Associate Professor of Chemistry at the University of Chicago.

PART III

EXPERIENCES IN THE UNITED KINGDOM

ON July 30, I reported at C.W.S. Headquarters in Tours and received orders to proceed via Paris to London where I was to collect certain data to be forwarded to Tours. The London office was directed to validate my travel in England, and I was instructed to acquaint myself fully with the mustard gas situation in that country. Thence I was to proceed to Washington and to report there for duty. On completion of said duty, I was to return to my proper station—which was Paris.

I went on to London as fast as possible, and got in touch with Wilbraham of the British Munitions Department. From him I learned of the developments which the Pope process had undergone on its native soil. The first people in the field were the famous chemical firm of Castner and Kellner at Widnes. Their process had been abandoned before I reached England, and so I learned about it only from hearsay. It was a monochloride method principally distinguished by the fact that it attempted to absorb the ethylene in sulfur monochloride by mixing the two substances together in a large tumbling barrel.

Independently of Castner and Kellner's efforts, the British government had been working at mustard gas manufacture in the gas arsenal at Avonmouth, near Bristol. The Avonmouth group had made considerable if slow progress, when, some time in June, the dye firm of Levinstein Ltd. in Manchester came forward with a new method. At that time their process had not yet passed beyond the semi-commercial stage, but it nevertheless bid fair to surpass all others. Sharp disagreement as to the merits of their respective methods ensued between the Levinstein and Avonmouth groups,

each of which had adherents in the Munitions Department. This argument long outlasted the war; as late as 1920 its echoes still resounded in the English chemical periodicals.

But, in August 1918, I was blissfully unaware of this conflict. My letters of introduction were to Wilbraham, who was a partisan of Levinstein. Consequently, I heard of little but the Levinstein method, and became an ardent Levinsteiner. In this frame of mind, I went down to Manchester where I spent an exceedingly instructive week.

The father of the Levinstein who, in 1918, was head of the firm had emigrated from Russia. He had founded what had become before the war the largest synthetic color manufacturing firm in Great Britain. At the time of my visit, it was overshadowed only by British Dyes Ltd., a government corporation built up during the conflict. The Levinsteins have, by the way, since combined with this firm.

The mustard gas plant was at Blakeley, a manufacturing suburb of Manchester. The head of the laboratory there was a well-known dye chemist named Green, who was also a professor at the University of Manchester. His assistant on the mustard gas project was a young chap named Oxley. What Green and Oxley proved was far more important than the use made at Manchester of their results. So the subject is best discussed on that basis. They made four vital discoveries.

- (1) That the best way of making ethylene from alcohol is to pass the alcohol over heated coke soaked with phosphoric acid. The efficiency of this process is equal to that of any other process, and the ethylene so produced is considerably purer. This is important because slight impurities greatly hinder the absorption of the gas.
- (2) That, in order to get the ethylene to react smoothly and rapidly with the sulfur monochloride, the gas must first be very carefully dried.
- (3) That, in order to make the mustard gas reaction run at reasonable speed, the liquid (sulfur monochloride) and the gas (ethylene) must be thoroughly intermixed. The agitation must be effected by a splasher. It is not sufficient merely to swirl the liquid around with a stirrer.
- (4) That, by keeping the temperature in the reactor below 35° Centigrade, all the sulfur can be kept from depositing, and the reaction can be run in a cast-iron vessel. This last find was the most important of all. It did away at a stroke with the expensive lead construction of the Usines du Rhone and the sulfur troubles of the Chlore-Liquide. In fact, it fairly revolutionized the problem of large-scale production. Had it only come six months earlier, it would probably have altered the course of history.

IN August, the Levinstein plant had scarcely passed beyond the experimental stage. During the month previous to and including my visit, it had produced only 15 tons. But the working force had shown considerable ingenuity in devising a very simple ethylene furnace. Moreover, they had installed an agitator in their reactor which made it possible to absorb almost every bit of the ethylene, something that no one else had till then succeeded in doing. The appliance consisted of a hollow truncated cone half immersed in the fluid. When the cone was revolved it threw the liquid upwards in an umbrella-shaped spray. Under these conditions, the reaction proceeded with great rapidity.

Otherwise, the plant was very crude. The absorber, for instance, was cooled by immersion in a tub of ice and salt like a big ice cream freezer. Still, it must be remembered that all this was only experimental scale work. And besides, I saw the plant under unfortunate conditions. About a week before my arrival, it had been wrecked by the stupidity of an employee who had so mismanaged the valves that he had blown the heavy cover off the reactor. This cover, in falling, had tumbled onto a line of shafting and had strained every joint and bearing on the machine. As the apparatus stood, it rather reminded me of a man who had been on a nine-day bat. And it worked about as efficiently. I remember I noticed some odd looking lumps on the big ethylene meter. When I inquired what these were, I was told that the meter had been split by the explosion, and that the chinks had been patched up with clay, pending the arrival of a new instrument. Under such circumstances, it was hardly to be wondered that the books showing material consumed and product turned out were in a state of chaos. To get any information about cost was next to impossible. I came away with considerable respect for the French control methods which I had previously considered so fussy.

The Levinstein people were proceeding with the erection of a full-size plant which I do not think they got finished in time to operate before the Armistice. But they had so successfully demonstrated their points that the Avonmouth group had adopted most of their views. So Avonmouth was erecting a much larger plant to be operated pretty much in conformity with Levinstein principles. I was much tempted to visit the place. But time pressed and, since they were doing very little pending the erection of their refrigerating plant, and I had already been much delayed, I decided that it was best to come home at once.

The Avonmouth performance, according to their own record, was as follows: Experimental and semi-scale installations produced in all about 112 tons of mustard gas. The permanent plant produced 8 tons a day from September 12th to November 12th, 1918. New units in process of erection would, by December 1st, have increased this output to 70 tons a day.

PART IV

THE MUSTARD GAS PROGRAM IN THE U.S.

IARRIVED in Washington on September 3rd and was sent at once to the Chemical Warfare Service arsenal at Edgewood. Capt. Pope, who had been in England early in July, had come back to America before me, and had already arranged with the high command to put up at Edgewood a mustard gas plant modeled after the Levinstein factory. But in order to understand the situation on this side of the water, something must be said about the way the gas service was organized.

The gas manufacturing branch of the C.W.S. was divided into three parts. The research division, under



Mustard Shell Filling Plant at Edgewood Arsenal, World War I.

Col. Burrell at the American University just outside of Washington, did nothing but laboratory research. The development division, under Col. Dorsey in Cleveland, was charged with the problem of taking over processes worked out in the laboratory and developing them on a factory scale. The production division was the Edgewood Arsenal, under Col. W. H. Walker, previously and since a professor at the Massachusetts Institute of Technology. The main mustard-gas plant (100 tons per day) was to be at Edgewood, Maryland, but there were to be two smaller stations—one (50 tons per day) in Hastings-on-Hudson, and another (50 tons per day) in Buffalo.

I can speak only of the results accomplished at the American University, for Captain (later Major) Pope and I had little to propose in the way of research. Hence I spent only half a day in the research division. But what I saw was disappointing. A good deal had been done along physiological and toxicological lines, but, in the matter of improved synthesis, little progress had been made. The main points discovered in Manchester by Green and Oxley had escaped notice.

At Cleveland and at Edgewood it was necessary to contend with many difficulties. In principle, everyone accepted Levinstein's results, but each man had some little idea of his own which he believed could be incorporated in the process, greatly to its improvement. Part of these ideas were good; part were foolish. To have accepted some and rejected others would have required miracles of tact. Finally, we had to take the stand that we would vouch for the Levinstein method if it were installed as we had seen it installed—excepting always for the correction of proven errors. But if any other changes were made, we could not be responsible for the results.

Finally we got our way in all essentials, and, while we were waiting for the large equipment to be set up at Edgewood, I went on to Cleveland, Hastings, and Buffalo. At Cleveland they had worked out the ethylene furnace which had been adopted for all large-scale work in this country. Kaolin was used to split the alcohol into water and ethylene. This substance works fairly well for a short time, but quickly plays out, and has to be regenerated by being pressed into the form of vermicelli, and baked. The method used was to pass the regenerated clay vermicelli in a constant stream through the furnace. This meant a very cumbersome apparatus and one which did not turn out specially pure ethylene. However, the installation was so far advanced at Edgewood, Buffalo, and Hastings that it could not be changed; so we confined ourselves to trying to get the Levinstein furnace adopted for future plants.

At Cleveland, the mustard gas work proper was in charge of a brilliant young man named Venable, a graduate of "Tech." He took up the Levinstein scheme enthusiastically, and began at once to accumulate val-

uable data. Moreover, he worked out a diagram showing the relation between the amounts of ethylene and sulfur monochloride run into the reactor, and the concentration of the various components inside. This chart was as clever a piece of work as I have seen. It proved a godsend later on at Edgewood.

CONCERNING Buffalo and Hastings there is little to be said. The work there was in capable hands, but the installation was only planned to be complete in December. Neither plant ever ran. If they had done so, they would have used the Levinstein process. So far as I know, only one private firm in America ever came forward with a method for mustard gas manufacture. It was the Dow Chemical Company.*

At Edgewood, to which place I returned on September 24th, there was already a small plant in operation. In June, a Captain Hanson had been sent to Pont de Claix which, with its very simple apparatus, had rather beat the Roussillon plant in the getaway. He had returned to Edgewood, and had installed some ten reactors similar in all respects to those used by the Chlore-Liquide. His experience was just what theirs had been: constant trouble on account of pipes and valves clogged with sulfur, frequent accidents and numerous shut-downs. He used up alcohol like a drunken sailor. Over half of it was wasted, but in return his product was more nearly free from uncombined sulfur monochloride than any other I ever saw. Later, acting on results obtained in Cleveland, he had built two slightly larger reactors, and fitted them with agitators. Under this arrangement, they worked rather better than before, but the difference was not great. I mention the point to show that, whenever any mustard gas process underwent evolution, it developed in such a way as to make it more like the Levinstein method than it had been before.

The large-scale plant at Edgewood was still not ready, and so I got in touch with Felsing, the lieutenant in charge of the chemical control work on the process. He was also a "Tech" graduate and as good a man as

*"No one at Dow relished the assignment of making mustard gas. But the company turned out as much as 10,000 pounds a day. After the war, the remaining supply was buried at sea." From "The Dow Story" by Carl A. Gerstacker, vice president and treasurer, The Dow Chemical Co., Armed Forces Chemical Journal, July-August 1956, page 34.—ed.

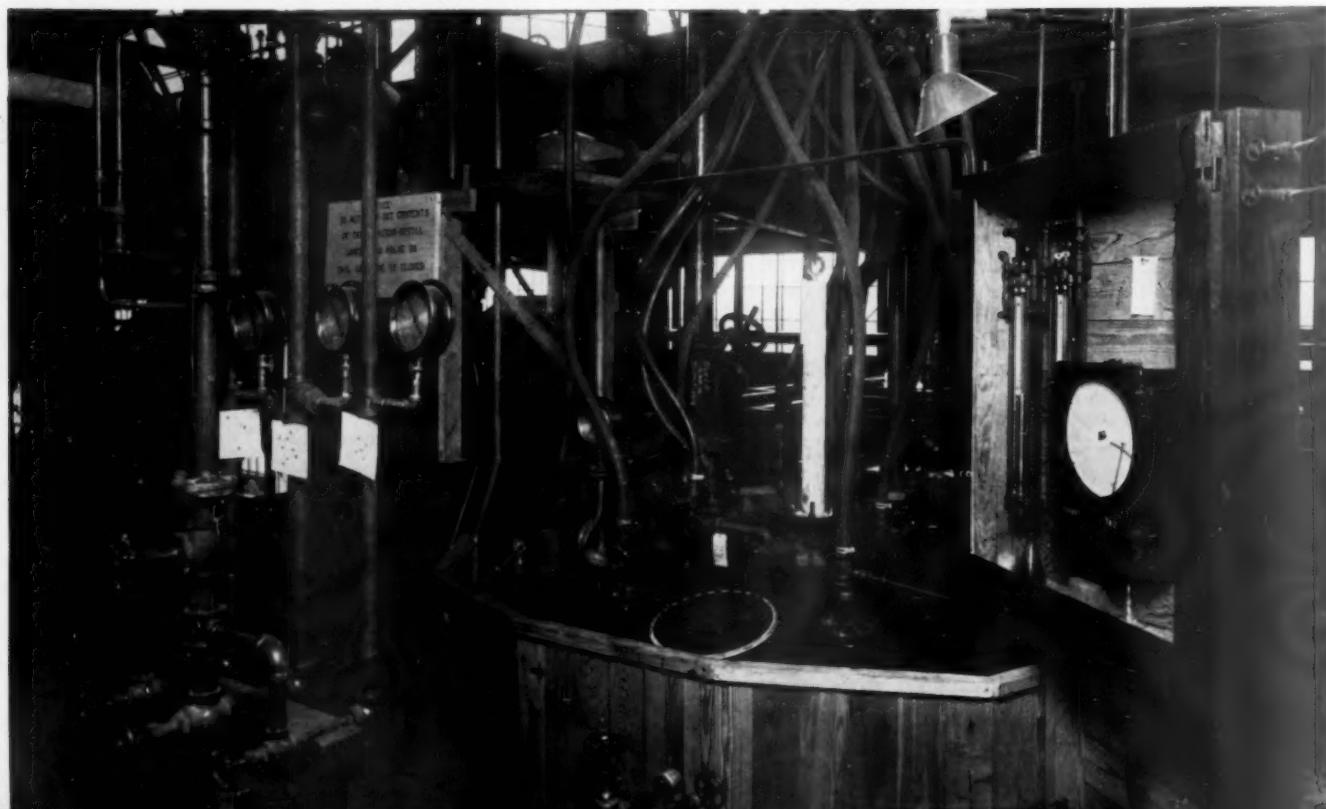
Venable. We took advantage of a little analytical trick which I had first seen used qualitatively at Pont de Claix, and which had been developed quantitatively in the British government testing laboratory at Crewe. Combining this method with Venable's concentration diagram, we were able to devise a system of control which completely outclassed anything I had seen. When our big reactor got working, we knew as much about what was going on inside that eight-ton kettle filled with poison as we could have known if it had been an open beaker of salt solution.

Just about this time Major Pope told me that he had no further use for me, and that I might go back to Paris; but I stayed on, at the request of the boys in Edgewood, to help them with the first runs. Finally, on October 4th, all was ready. It was a tense moment, for Major Pope and I were to stand or fall by the results. Owing to a breakdown in the refrigeration system, we ruined the first batch. The second was a brilliant success, and, by the time we left the operating platform, our equipment was turning out in eight hours six and a half tons of a clear amber liquid containing over 70% of pure mustard gas. Not a flake of sulfur had appeared, not a serious flaw in the construction had developed, 85% of the ethylene was being absorbed, and the sulfur monochloride content of the finished liquid was so far below the allowed limit that our stuff would have stood the long journey in the shell from Edgewood to the Argonne without serious deterioration.

THE plant was not perfect. Several details which Levinstein had used successfully proved to be inapplicable to so large an installation. The refrigeration plant required considerable alteration. But the single unit, as it stood, ran smoothly till the Armistice. Before that time, there was installed another slightly larger apparatus, to which were attached most of the supposed improvements which Major Pope and I had rejected. It had to be shut down, or rather it shut itself down after three days use.

As far as the Allies were concerned, mustard gas played but little part in deciding the conflict. The American program called for 200 tons a day by January 1st, 1919; and, in view of the progress made, I have no doubt this output could easily have been attained. After

Levinstein Mustard Gas Reactor Operations Platform at Edgewood, World War I.



Major Pope and I left Edgewood, the problem was no longer one for the chemist but one for the construction engineer. All that was necessary was to install more units identical in every important respect with the one we had set going. The subsidiary program calling, in case of necessity, for 500 tons a day by May 1st, 1919, would also, I feel sure, have met with no difficulty.

Speaking as of May 1st, 1919, when the Americans would have been receiving 200 tons of mustard gas a day on the line, and, estimating the British output by that time at 100 tons and the French at 80 tons a day, the Allies would have had at their disposal 380 tons of mustard gas per diem. The old Victor Meyer method never yielded the Germans over 10 tons a day. They had, however, picked up some French duds, and had, from analyses, inferred the method by which the material was made. At the time of the Armistice, they were erecting a plant which was to use some sort of a sulfur chloride process. But I think it safe to say that, by May 1st, the Allies would have enjoyed the advantage of an overwhelmingly superior supply of mustard gas. Unquestionably, the Germans foresaw this state of affairs. In my opinion, this anticipation was one of the reasons why they sued for peace before the end of 1918.

THE ARMY AT HOME AND ABROAD

(Continued from page 23)

So far, I have discussed at some length the Army at home and abroad—what it is, what it does, and *why* it lives in your communities. Now I want to express my concern over *how* it lives in your communities. For many years, prior to World War II, The Army, living in small detachments scattered over our western frontier or along the seacoasts, made no sensible impact on civilian community life. The term, community relations, was unknown in the book of Army commanders of that day. But all this has changed with the greatly expanded Army, and the maintenance of good community relations has become the business of all commanders at all echelons. Let me say that I would like your comments on how we are doing.

One device which has proved most helpful is the use of Civilian Advisory Councils. We now have in the United States nearly 100 active councils established in areas of concentrated military strength. These groups are composed of leading citizens who are willing to help in the improvement of Army-community relations.

Army installations are urged to make their stations welcome neighbors of the communities near which they are located. Individuals of the Army are encouraged to participate in the activities of local communities wherein they reside. You will find them in many activities of your cities. A new activity is our program for counselling junior rocketeers, helping them to get their rockets into the air without the rocketeer accompanying the missile.

Overseas, our community relations are complicated by the requirements of adjustment to a foreign environment. Moreover, mistakes there are compounded and magnified by their political and international consequences. But the civilian advisory council concept seems to work there too. By and large, the American serviceman abroad is showing himself a worthy representative of our Nation.

No one service alone can keep us secure. They are all needed to maintain flexible, military strength proportioned to meet the requirements of any challenge.

To be successful in their efforts our Services need the support of public understanding. It is in this field that I invoke the aid of all of you civilian leaders present in this gathering. In the long run our military forces will

never be better than they appear in the eyes of their countrymen. Increased pay, amplified fringe benefits, and the like are not sufficient to obtain the dedicated servicemen required in the long pull for our national security. In addition to these material things, they must have the respect and support of their fellow citizens. This is not to call for a glorification of the military but rather for the around-the-year acceptance of the serviceman as an indispensable and respected member of our national society.

The requirements of this security are not presently light, nor are they likely to be materially lightened in the future. There are no wonder weapons or devices which I know about which offer the hope of reducing the requirements of our Service for men, money, and equipment. We are facing a long period of tension wherein our national military posture must be maintained, even at a great effort.

DEFENSE CHEMISTRY

(Continued from page 21)

The radioactive isotope, carbon-14, is now being used to detect those substances present in motor fuels that cause engine deposits. Additives that control this tendency often increase spark knock. By eliminating aromatic hydrocarbons with long paraffinic or olefinic side chains, engine deposits are greatly reduced without use of additives.

Expensive hafnium, which is obtained from difficultly producible zirconium to the extent of 2% of the weight of the latter, is now being replaced in reactor control by a simple alloy of cadmium, indium, and silver. It has high ability to absorb neutrons, resists high-temperature corrosion, lasts as long as most reactors, is easily fabricated, and is relatively cheap. In the meantime, search is continued for a material that is as efficient as hafnium.

Research on nuclear radiation damage of military materiel is typified by studies of effects of such radiation on military-specification paints. Resistance to such damage is greatly lessened by the use of silicone-alkyd, alkyd, and phenolic-resin-based paints, as well as by employing carbon black and red pigments rather than white pigments.

Polyphenyl ethers are not only effective lubricants, and hydraulic fluids in terms of heat and oxidation resistance, but also are so little acted upon by nuclear radiation as to be used as reactor coolants.

More serious than damage to materiel is the damage of radiation to the bodies of men. On the one hand diagnosis of radiation effects may be made by the differences in ordinary hydrolysis and radio-hydrolysis of body proteins. Dosages below the lethal level produce effects which can be detected by a color test, employing 2,4-dinitrophenyl hydrazine. Also labeled carbon 14 acids give clues to radioactive damage. On the other hand, tests on animals indicate that a type of thiouronium compound locates in bone marrow and functions to protect against damaging radiations by cutting effects in half. No protection, however, is afforded to eyes, brain, or the reproductive system.

FOOD IRRADIATION

LATHROP, Calif., (ANS)—Plans are now being developed to build the Army Ionizing Radiation Center here at Sharpe General Depot. Primary mission of the Center will be to develop methods of using ionizing radiation to preserve foods and establish the commercial economics of the process.

SPACE LOGISTICS

(Continued from page 10)

Dr. Homer E. Newell, Jr.

(Dr. Newell, the next speaker, is Acting Superintendent of the Atmosphere and Astrophysics Division, of the Naval Research Laboratory.

He said much of the information published over the years about environment of space and of the nearby planets, is now known to be incorrect—adding that we are now on the threshold of establishing the facts through experiments. He noted differences in conditions to be encountered in space as compared to those on atmosphereless bodies.)

In space we do have certain well-known and accepted conditions:

One—Temperature equilibrium of an object is controlled by: a. Heat input from radiation, mainly solar. b. Heat sources within the body. c. Heat output through radiation.

Two—Besides infrared and visible light there are other radiations—ultraviolet from the sun, and particle radiation. The latter can be highly energetic (Cosmic Radiation)—more energetic than any particle radiation we can produce artificially on Earth. Because there is no light scattering, the difference between shadow and light zones will be extremely pronounced.

Three—Space is an extremely high vacuum. But there are a great number of small objects going through space in all directions: Meteors and micrometeors. The latter cannot penetrate even thin metal sheets, but may be a nuisance. The probability of being hit by a meteor is quite high. As means of protection seem possible, the actual danger may not be too high.

Four—And of course, inside a free moving object there is no gravitational acceleration.

On atmosphereless bodies, we find conditions somewhat different—

First—Temperature is influenced by conduction and shadow-light distribution.

Second—Half the radiation and meteors are held off by the body. If there are deep canyons, etc., a near-complete protection seems possible.

Third—Gravitational acceleration is non-zero.

If an atmosphere is present, then we have an evenly distributed temperature and convection governs heat transfer. Light scatter lessens the difference between light-shadow zones, and a rather complete radiation and meteor protection is provided. As atmosphere composition and pressure on Mars and Venus is different from those on Earth, breathing equipment has to be worn. There is a possibility that a full pressure suit may not be necessary.

Lt. Col. Rufus R. Hessberg

(Colonel Hessberg directs the Aero Medical Field Laboratory at Holloman Air Force Base. His work was described as primarily in the area of bio-dynamics and biophysics covering "environments of weightlessness and high 'g' conditions."

Colonel Hessberg discussed the matter of moving cargo in weightlessness.)

It is obviously a problem to both the man and those responsible for packaging the man in the space vehicle. I consider it vitally important that the man be given an environmental situation approaching his earth-bound sensations as nearly as possible through design and packaging techniques. By this, I envision perhaps that the man will be packaged in a metallic cloth suit. He will sit in a seat that has a switch which, when turned on, will energize the electro-magnetic field in the seat

that will hold the man through his suit firmly in the seat, and that he will experience the same or similar feelings as that which we experience sitting in our seats on Earth. Now, all the man has to do is switch off this button and the electromagnetic field stops, and he is free to float out of his seat or to travel to some other part of the spaceship or his space-station.

Likewise, I feel that it is equally important that the man be implanted on the deck, or in the spaceship when he is moving cargo. True, the cargo will be weightless, but I think the man should have a feeling of security and firmness when he is involved in moving. Whether he will be firmly implanted with electromagnetic shoes, or on an electromagnetic belt that will move while he holds the cargo and pulls it with him as the belt moves, or whether some other packaging device will be designed and invented, I cannot say at this time.

(Colonel Hessberg concluded with the statement that some means to insure proper exercise under a situation of weightlessness will be necessary to maintain normal "muscle tone.")

Brig. Gen. Don D. Flickinger

(General Flickinger, director of Life Sciences, and special assistant for Bio-Astronautics, at Headquarters, Air Research & Development Command, was introduced as "one of the most outstanding authorities on Aviation Medicine in the country.")

There is certainly good reason to consider the problem of high acceleration at the same time we are thinking about gravity states and weightlessness; this is partly because they have a reciprocal relationship to each other physiologically, but, from the practical design standpoint, both factors must also influence many of the same items of basic structure and hardware in the man's environment. The seat, for example, must cushion the space cabin occupant adequately while he is being launched, as well as stabilize him and provide him a fulcrum from which he can exert his own mechanical force upon controls and other objects around him when he is weightless. Such dual purpose design would obviously be of the greatest importance in the earlier space vehicles, where we will be working within the strictest kinds of limitations on weight and space. Colonel Hessberg has already talked about some of the special considerations during the second phase of our dilemma.

Insofar as the first half of this design challenge is concerned, that is, how well will our space man do when he is being accelerated during the launch phase, I think we already have passed some reassuring research milestones. We can now be reasonably sure, on the basis of a long series of experiments on the Johnsville and Wright Field centrifuges, as well as on the basis of John Stapp's sled experiments, that there is nothing basically intolerable about the acceleration intensity and time curves it will be necessary to use to launch useful payloads into orbit, or onto any foreseeable celestial course.

It is clear that when rocket accelerations never exceed peaks of 6 or 7 G's applied in three gradually increasing and rapidly decaying increments over a period of 4 to 5 minutes—and this is sufficient to place a vehicle in orbit—the resulting acceleration effects are well within human tolerance. Placed in a semisupine position, the man will experience only feelings of having become very heavy, mild difficulty with breathing owing to the weight of his chest, and great difficulty with arm and leg movement. Fingers and hands, however, will still be movable and speech will be possible, although not easy or normal.

These effects are qualitatively similar, but not as se-

vere, perhaps, as those experienced during the deceleration occurring in re-entry.—(Discussed by next speaker, Captain Bossee.)

Captain Ronald A. Bossee

(The next speaker, Capt. Ronald A. Bossee, is director of the Air Crew Equipment Laboratory of the Naval Air Material Center, which is responsible for the test and evaluation of all naval escape and survival equipment.)

The problems engendered by deceleration on re-entry into the Earth's gravitational and atmospheric environment are formidable but not in the light of present accomplishments, unsolvable.

The stresses of deceleration insofar as the physiology and anatomy of exposed humans are concerned are the same as those engendered in the acceleration stresses on escape from the Earth's terrestrial influence. In a body progressively slowing down we have a changing velocity which generates G stress in the same manner as that in an accelerating body.

The G stress is applied in a reverse direction, but its influence on the fluids, tissues, and supporting structures of the body is the same. This is true of equipment also.

Compared to escape, the problem of re-entry seems more complex. To escape, the object starts slowly, increases in velocity, and consequently in acceleration, stress reaching a maximum of 7 to 8 G's after which it drops back to near zero. This cycle is repeated over 3 or 4 minutes and culminates in constant speed in a weightless medium.

On re-entry, however, the space craft, should it follow the same path, would terminate not in a weightless void, but in solid earth. Hence, reverse forces must be applied to the space craft as it approaches the Earth to slow it down. This appears to be a simple matter; however, the deceleration force developed will be of great magnitude unless a certain re-entry flight path is utilized.

Another potential danger to the humans and equipment in the spaceship is that of generation of friction heat as the spaceship enters the atmospheric belt of the Earth. In practically all cases, meteorites are burned to nothingness on entry into the atmosphere of the Earth at high speed. No decelerating forces are applied to the meteors (except air drag) as they approach the Earth and thus they are exposed to greater friction heat than a decelerating spaceship. In addition, the present development of heat resistant nose cones will alleviate the effect of heat during re-entry on men and equipment in a spaceship.

In the approach to landing on the Earth's surface, three flight paths may be considered. The first one, the direct head-on landing must be eliminated because of the potential development of extreme deceleration stress endangering men and equipment. The second flight path is referred to as the "skip path." In this type of approach the space vehicle skips in and out of the atmosphere as it orbits the Earth gradually penetrating deeper into the atmosphere and slowly decelerating. While deceleration stress is estimated to be within tolerable limits by this method, the generation of varying radial stresses may be damaging to equipment and men. Certainly it will be uncomfortable.

The final and accepted flight path is one of gradual slowing down by entering the Earth's atmosphere at a very small angle and progressively orbiting the Earth to a final landing. It is estimated that with an entry of this sort a bell-shaped curve of deceleration stress will be encountered covering a period of four minutes. The

peak G will be less than 10 and 30% of the G loading will be below 7G.

With present methods of positioning spaceship occupants this is well within tolerable limits. Certainly equipment can be protected against this force.

The Navy's Aviation Medical Acceleration Laboratory at Johnsville has been exposing human subjects to 21 G safely with no undue discomfort in a specially built NACA supine seat of their centrifuge.

It would appear then that the deceleration problems on re-entry insofar as the human occupants are concerned can be handled. The matter of protection of equipment is serious, but not insurmountable. If they can be packaged for 10 G plus for 4 minutes plus, they should be able to survive to function again.

(At this point Mr. Koelle observed that "space flight will not be really profitable until we have learned to return payloads from space to the surface of the Earth." "For manned space flight" he said "the return is even more important, it is mandatory. Therefore, this problem draws considerable attention these days. It is as simple as that: without solving the recovery problem in a reliable manner there will be no manned space flight."

He went on to list the various kinds of design and controls of recovery vehicles which will have to be considered, including Payload, Shape, Attitude Control, Velocity Control, Re-entry Initiation methods, Retardation Phase problems, and, finally, the Terminal Phase, including such problems as Terminal Guidance, Subsonic drag devices, impact brake rockets, Shock Absorbers, Floating Gear, Navigational aids. He stated that "in all these design considerations, weight will have to be kept to a minimum because all of this recovery gear has to be placed in orbit first.")

Mr. Robert B. Demoret

(Mr. Robert B. Demoret, Chief of the Astronautics Section, Denver Division of the Glenn L. Martin Company, is primarily concerned with performance and design studies of space vehicles and large booster systems.

Mr. Demoret dealt with the weight problems in connection with the design and construction of future orbital vehicles.)

From a system engineering standpoint, one of the most difficult problems we face is that of obtaining equipment and sub-systems which are weight minimized to the fullest extent. The aircraft industry has, of course, always been concerned with this problem. If we look at the facts of life in the engineering design of these space vehicles, we find that we will be moving one to two orders of magnitude up the sensitivity scale from anything that we have been doing in the past. For a new design one of the parameters of interest is the growth factor, the ratio of gross weight to payload weight. In the design of airplanes we have generally been working with growth factors of from 5 to 15. Even for our long range missiles the growth factor has been well under 100. If we look into the future to a vehicle that might travel to the Moon, land, and then return to Earth our current propulsion systems would require a growth factor of almost 1000. On the basis of current costs such a vehicle might run approximately \$100 per pound to build and launch, each added pound of weight unnecessarily left in the payload package would cost approximately \$100,000.

The earliest space systems will be tailored to match the payload capability of existing booster systems. That is to say that the payload weight allowed will be fixed. Thus, each extra pound of weight in one item means that one pound of some other equipment item

must be left out. For these early systems this basically means that less information will be obtained from each flight: For a manned orbital vehicle, that time which we could leave the man in orbit would be reduced because we would have to limit his food, water, oxygen, and air conditioning by this amount.

Mr. Vincent Blockley

(Following Mr. Demoret came Mr. Vincent Blockley, Human Factors Specialist in charge of the Physiological Effects Unit of North American Aviation. It was stated that he had contributed greatly to the advancement of man in space with his experimentation and studies of human heat tolerances and aviation physiology.)

While man's ability to tolerate extremes of temperature and pressure for short periods is impressive, the extended durations of contemplated space missions require considerable mass as well as much engineering ingenuity to maintain the thermal and atmospheric environment within acceptable limits. Most basic of the life support requirements is the need for oxygen, which is consumed at the rate of roughly two pounds per day per man with moderate activity. The oxygen requirements, and consequently the CO_2 disposal requirements will vary directly with the amount of physical work required of the man, and, of course, with the duration of his sojourn in space.

A second by-product of the consumption of oxygen is the production of heat. While the amount of this body-generated heat is comparable to that produced by a conventional incandescent light bulb, a positive means of removal must always be available since any prolonged damming back or storage within the body leads to lowered efficiency, then collapse, and finally death as the internal temperature rises.

Atmospheric and thermal control, then, require a constant supply of conditioned air at a suitable pressure, with the right composition, humidity and temperature. In a large conditional cabin, with the men dressed in conventional clothing, the techniques used will differ only in minor details from currently used methods of air conditioning. Ironically, the thermal problems will be more severe in the early phases of our space program when cabin volumes are restricted and men are dressed in protective impermeable suits. Under these conditions, removal of metabolic heat may be largely dependent on the evaporative process, requiring the provision of large quantities of drinking water and means of reconstituting water from the recirculated air for reuse.

In a properly designed ventilation garment man can successfully withstand a steady-state environmental temperature of 250°F for 45 minutes, or 200°F for an hour and a half. Tolerable exposure durations would be considerably increased if the air and wall temperatures of the enclosure were raised gradually from an initial comfort level.

A perfectly insulated man, neither losing heat to his environment nor gaining any from it, could work for half an hour to an hour before reaching a critical state of overheating.

(At this point Captain Bosee was asked to comment on the use of space suits.)

Capt. Ronald A. Bosee

The first occupants of space craft as crew members will undoubtedly be clothed in full-pressure or so-called space suits.

The full-pressure-suit will automatically provide an internal environment of 35,000 feet altitude equivalent, should decompression of the spaceship occur.

(Movies were presented at this point to show "the sequence of explosive decompression.")

"The graphic illustration of things being thrown about in explosive decompression illustrates that further consideration should be given to equipment" it was stated).

Dr. Otto H. Schmitt

(Dr. Otto H. Schmitt, of the University of Minnesota's Physics Department, the next speaker, dealt with the bio-physical problems of space travel.)

In our early efforts we shall be pleased if we are able to put a man and his necessary equipment into space for a short period with the man in sufficiently good shape physiologically and psychologically to function to the extent of performing limited observational and control functions. We do not expect him to be particularly comfortable; we do not expect him to be operating at maximal mental and sensory acuity; and we are fully aware that he will not be able to contribute very much during the crucial take-off and re-entry periods.

As we progress technologically beyond the point where we can just barely put a man in space for a short period and recover him in good health, we will surely be considering the kind of environment that must be provided for him if he is to make longer sojourns in space and is to be physiologically, psychologically, and emotionally prepared to do an efficient job. We might liken the first of these two kinds of space biology to the short term stress that can be borne while a man dives into cold water, looks about under the water for an object and recovers it, all within a few seconds. The second we can compare with the long term limited conveniences that can be afforded him by a diving lung, or better yet, a submarine from which to operate.

In the short, high stress trip, we can supply the man oxygen from a tank and need not resort to complicated purification methods. We can keep him heavily restrained with respect to bodily motion and can depend on the excitement and importance of the mission to keep him at maximal effort and strongly motivated to do an effective job during such flights. When, however, the trip is longer, we must give him a reasonably comfortable, not too frightening, not too boring an environment in which to work, and we must meet his physiological needs more thoroughly. Especially in this latter case, I think you will find very new and challenging packaging problems. Just one of these—the problem of food, drink, and air requirements as a particular case that requires major packaging developments. Then we must give up the idea of supplying sufficient oxygen, in either liquid or compressed gas form, to last out the voyage. Similarly, we cannot afford simply to absorb all of the carbon dioxide produced, and we will probably have to go beyond the time for which we can store food without running to excessive weight. We consequently come immediately to the problems of a closed ecology; that is to say, the microcosm, or a little independent world in which we have to reprocess our metabolic substances, including food, water, and air, so that with only the expenditure of available energy these become useful over and over again, much as they do on Earth with the aid of vegetation to regenerate oxygen from carbon dioxide and other natural processes to remake water and food. It seems at this time that the simple algae, which are a primitive kind of plant life living in water, will be the most effective way of converting exhaled carbon dioxide back into available oxygen.

As you know, it has now been shown that the space to be penetrated by space vehicles includes some relatively unexpected intense radiation components in the

strongly ionizing range. I would hate to sketch a packaging arrangement for conducting this photosynthesis on a scale large enough to support one or several humans, but I am sure that some among you would consider this a straightforward task.

Going on with the closed ecology idea, the algae actually are potential food, but not an especially palatable one in their simple form. A sizeable crop of these organisms can undoubtedly be harvested as a by-product of oxygen purification again with the utilization of sufficiently clever packaging arrangements whereby a portion of the algae can be withdrawn and processed for food as they grow. Whether this transformation involves direct chemical processing or an intermediate biological stage, I am not prepared to say. I think it very likely that this material can form the basis of suitable and attractive food.

In arranging all of these fairly elaborate biochemical procedures, we will find many unexpected problems. Who would suspect, for example, that a photosynthesizing algae would also produce carbon monoxide as well as oxygen, yet this is claimed to occur.

I would like to mention briefly some truly biological problems. Humans, other animals and plants have a complicated set of built-in or innate rhythms which are not fully understood but which enter fairly strongly into their behavior and ability to perform. Our bodies, in many ways, perform in accordance with the natural twenty-four hour day, and while we can disrupt this cycle to a limited extent, it is possible that we will have to arrange an environment somewhat like the regular day-night environment, or we may have to condition our space travelers to a different regime by a protracted period of adaption to this new environment.

General Flickinger

(At this point General Flickinger commented that it is of great importance in interpreting the signals or responses from the spaceship to know what the occupant is actually doing to cause the particular radio or other signals which are received, and continued—)

Such communications could assume a great number of forms, inasmuch as extensive and ingenious sensing devices and read-out systems have long been a part of our laboratory experimentation. I am sure you know that we have telemetered various physiological measurements, such as heart and respiratory rates, electrocardiograms, oxygen contents of helmets and face masks, carbon dioxide content of the inhabited compartment, and so on, to ground level in order to monitor subject conditions. This is good data, as far as it goes, but as a matter of fact interpreting it presents some problems. If you have some other sources of data which allow you to comprehend the operational situation and determine what action is going on, then the physiological and biochemical data helps you to understand how well off the subject is. But if you don't know what the subject is doing, the physiological data is susceptible to a great deal of misinterpretation and could be the cause for a great deal of unnecessary alarm.

For these reasons we see a need for excellent aural, and if possible visual, communication between the space-man and the ground monitors. This means two-way radio and at least space-to-ground TV, and it seems at least possible that the activities of the individual might be followed by causing them to trigger display indicators on the ground. The opening of hatches, for example, or the manipulation of controls, or the shifting of body mass might all be sensed and conveyed back to the ground as an indicator of significant individual actions.

Such monitorship would be doubly important if trips outside the space capsule were necessary.

Moreover, certain long-term monitoring functions might be advisable. Examples of these would include periodic telemetering back to Earth of the man's accumulated radiation dosage, or periodic testing of the individual's reflex action speed or maximum exertable strength as an index of the effect of chronic weightlessness on his nervous and muscular system.

* * * * *

With the foregoing discussion the panel sought to inform the audience of the physical conditions under which the astronaut will operate and the means by which he will travel. The second portion of this session, which followed immediately, was devoted more specifically to the packaging problems involved in the procedures previously discussed.

Mr. Demoret opened this portion of the program, pointing out that in some cases perhaps the development of packaging may take advantage of the special characteristics to be found in outer space, namely high vacuum, weightlessness, radiation, heating or possible temperature cycling. "The primary thing" he said "is to look for potential improvements which can be made through taking advantage of the environmental peculiarities as well as making sure that we successfully contend with its problems."

Mr. Blockley followed with consideration of containers for oxygen, noting that there is an "unavoidable constant attrition of the contents during storage due to heat leakage through the vacuum insulation. "A liquid gas storage system," he continued, "is most effective when the attrition rate of the total stored quantity is just equal to the anticipated rate of usage. For example, a 25 liter LOX converter will last about 30 days, whether the contents are used or not."

Mr. H. Ruppe remarked that Professor Oberth's proposal for a spherical wire net to prevent material from floating away would not be sufficient protection for sensitive and living payloads, such as photographic materials, certain fuels, plants, animals and men, all of which would require protection against radiation, meteors, large temperature changes, and prolonged weightlessness.

Mr. Demoret stated that in order that the discussions should be held in proper perspective, the size and type of space vehicle "that we will be dealing with in the next few years" should be indicated. "Because of the time required to develop completely new designs" he said, "we will be restricted to using modifications to, or combinations of the missile systems that are available or under current development." "This," he said "means that the maximum weight of our early space vehicles will be quite limited. The estimated payload capability of our large missiles will be considerably greater than the current Explorer or Vanguard satellites but not sufficient to permit man to land on and explore the Moon."

"It is quite feasible" he said "for such systems to orbit a satellite weighing over 3,000 pounds. This amount of weight is adequate to accomplish scientific objectives of major scope including that of placing a man in orbit and safely returning him to Earth. Through propulsion system improvements and weight optimizations that can be made, a satellite of over twice this size could be put in orbit."

Mr. Koelle, at this point, exhibited diagrams illustrating payloads and economy in space flight, and stated: "The individual payload weight (Slide 5) is going to become larger with time. It started with 184 pounds in

Sputnik I, or 18.5 pounds in Explorer I. It has since reached 3,000 pounds and might be as high as 100,000 pounds around 1970." The growth factors, he noted should go down with time. "Vanguard I required 6,000, Explorer I 3,300, Sputnik I approximately 1,200, and Sputnik III approximately 150, or less, pounds take-off weight per pound payload delivered into orbit. This growth factor might eventually come down to 10 or less as the state of the art progresses."

Of special interest were the following remarks at this point, by C. L. Barker, of the Army Ballistic Agency. Noting the deficiencies of currently developed coatings, lubricants, and plastics for use under actual space conditions, he stated:

"Here is an area of great importance to you of the packaging and handling industry. Many of the materials for packaging, the lubricants and the coatings which are now in use may give us trouble in the space environment.

"Many of the plastics will lose their characteristics under space conditions. The plasticizer in polyethylene, for instance, will volatilize under vacuum conditions. Other plastics with high vapor pressure plasticizers will have the same trouble. Rubber will harden and become brittle.

"In the lubricant field we find that our oils and greases will also fail under vacuum. Graphite no longer retains its lubricating qualities when placed under high vacuum.

"Coating materials of organic base type must be replaced by other coating materials.

"Thus we see, considering only one of the environmental conditions in space, namely vacuum, that we must develop an entirely new concept in the field of packaging and preserving of cargo payloads."

Mr. Demoret here commented that a considerable amount of research on materials is being conducted through industry. He said, "One of the most interesting observations made to date is associated with the tendency of dry metals to form a cold weld when they are subjected to an impact. It appears that air normally acts as a rather effective lubricant. In a very high vacuum the surface molecules of two pieces of metal form a bond under the right conditions even in the absence of significant temperatures. This phenomenon could, of course, create some problems in attempting to fabricate structures in space, or to use sliding parts."

Referring to heat transfer in space, he stated that this is an area of research that will no doubt have to be increased.

Dr. Schmitt observed that packaging might be combined with an alternative utility, stating that weight saving in packaging might be made by utilization of containers made of edible food. He continued: "Perhaps some thought should be given to the unique properties of proteins which make them good structural material in the body as well as good food. Electron microscopy is currently revealing that such structural chains can be built and broken almost at will to yield films, lamellar or gel structures which have most useful structural properties."

Dr. Schmitt also noted that the process by which some animals change color, automatically adjusting to the surrounding climate, might be made use of in solving outer space problems of temperature control. "For instance," he said, "it is not unthinkable that films could be developed which would alter their spectrum of absorptivity and reflectivity as a function of temperature, so as to make the surface of space containers automatically adjust for the surrounding climate."

Dr. Newell here observed that due to environmental differences found, for instance, on Mars, Earth, the Moon, or in space, we must expect certain materials to be good in one place, but fail in another. He noted that certain lubricants may fail in space for such reason; that transistors could have difficulties due to the radiation. He raised the question also as to photographic materials. He added that the Martian atmosphere contained no oxidizing agent, so that possibly we could use materials there which cannot be used on Earth, such as sodium metal.

Mr. Ruppe noted that, for technical reasons, the launch and supply launch base for certain missions would require an equatorial space-station. "Thus," he said, "we would have a packaging problem not only for space conditions, but for tropical conditions too." He stated: "From an equatorial orbit, recovery would be simplified: on each revolution the satellite passes over the base or the intended landing area giving one a chance of landing on every revolution."

The concluding portion of the session dealt with the design aspects of the carrier vehicle and the payload compartment.

Dr. Schmitt noted: "There is the necessity for very substantial re-education of a human to operate in a weightless environment." He said that aviatorial experience even has shown that "a person needs considerable retraining even in executing such simple maneuvers as getting food to his mouth and moving about a room."

Mr. Ruppe, referring to space stations, said there probably would be provision of some form of artificial gravity. "If the station rotates," he said, "then everything on the inside will experience a centrifugal force; so there is a 'gravity', and 'down' means simply 'outwards.' There are some problems involved, as the heads of persons standing in the station will be in different gravity fields from their feet."

Mr. Barker stated that we cannot define the actual configurations of payload containers until carrier vehicles are designed, "but we can say that, in general, the payload sections will be cylindrical or conical in space."

"Liquid payloads such as fuel and water must be packaged to prevent sloshing during ascent to orbit and will require special transfer equipment and protection against freezing or boiling in the space environment. Foaming may be a source of trouble for some liquids."

Mr. Blockley added that "the design of hatches, passageways, and packages will have to take into account the dimensions and mobility restrictions of space suits and personal equipment."

Colonel Hessberg further commented: "There have been several references made to the eating problem in the weightless state. I would like to enlarge on this problem at this time. You can mentally picture the chaotic result of placing a tray full of food on your lap in the weightless state. A slight movement of your legs and you will be grabbing food out of the air from all parts of the cabin. This points up the packaging of solid food in proper containers in bite size pieces. We can't afford a slip with a forkful of peas. Liquids will have to be packaged in special squeeze containers and proper storage of reservoir sources will be required. Even the squeeze containers will have to be stored in specially designed containers to prevent a cabin full of fog, in the event of decompression."

General Flickinger noted the necessity and desirability of maintaining at least some fraction of a gravitational field or gravity-like force field in space sufficient to help an individual who had a job to do, and to keep objects

where they were placed. He also stressed the importance of arrangements to insure proper exercise to maintain muscle health of the space occupants.

Mr. Koelle, in summarizing, emphasized that the packaging of payloads for delivery to points in space is as important as the payload itself; that weight requirements for materials must be kept to the minimum. He urged all concerned not to delay work on packaging and handling of materials in space until "the first man has landed on the Moon," and concluded by expressing hope that the group will have a chance to meet again before the FIRST MAN ENTERS SPACE.

USE CONFETTI IN STUDY OF UPPER ATMOSPHERE

WASHINGTON, (ANS)—Army Signal Corps scientists use of metallic confetti to measure winds in the upper atmosphere was recently announced by the Department of Defense.

Using small Loki II rockets, the Army is shooting packets of confetti-like aluminum chaff more than 50 miles into space, then tracking them by radar to give, swiftly and accurately, an unbroken map of wind speed and direction. Such maps, say scientists, will now be available for the first time in history.

GALA RECEPTION AT OPENING OF INDUSTRIAL COLLEGE COURSE

Students of the Class of 1959 at the Industrial College of the Armed Forces and their wives were welcomed on 13 September at a reception given by the Commandant of the College, Lieutenant General George W. Mundy, and Mrs. Mundy, at Fort Lesley J. McNair, Washington, D.C.

General Nathan F. Twining, Chairman of the Joint Chiefs of Staff, and Mrs. Twining, headed the guests of the College for this gala occasion. The other distinguished guests included: Admiral Arleigh A. Burke, Chief of Naval Operations, and Mrs. Burke; General Lyman L. Lemnitzer, Army Vice Chief of Staff, and Mrs. Lemnitzer; Lt. General Emmett O'Donnell, Jr., Deputy Chief of Staff for Personnel of the Air Force, and Mrs. O'Donnell; and Lt. General Verne J. McCaul, Assistant Commandant of the Marine Corps, and Mrs. McCaul.

The College is operated under the supervision of the Joint Chiefs of Staff. Classes were started on 25 August opening a ten months course in the economics of national security and national defense readiness. The student body is made up of senior officers from all the services and key civilian employees.



Gen. and Mrs. Mundy (left) greeting Gen. and Mrs. Lemnitzer.

NEW DEFENSE METALS INFORMATION CENTER

The Defense Metals Information Center, operating under the direction of the Assistant Secretary of Defense (Research and Engineering), has been established at Battelle Memorial Institute according to a Department of Defense announcement.

With much broader responsibilities than its predecessor, the Titanium Metallurgical Laboratory, the new Center collects and disseminates technical information on titanium, beryllium, refractory metals, high strength alloys for high temperature service, corrosion and oxidation resistant coatings and thermal protection systems. Defense contractors, subcontractors and other suppliers, as well as Government agencies, will be served by the new Center.

Contractors and other Defense suppliers may request information, advice and other related services from the Center, Battelle Memorial Institute, 505 King Avenue, Columbus 1, Ohio.

Information disseminated by the Center will be made available to the general public through the Office of Technical Services, Department of Commerce, Washington 25, D.C.

DETTRICK PUBLIC RELATIONS BOOSTERS RECEIVE AWARDS

The Department of the Army awarded Chemical Corps Certificates of Appreciation to Mr. William T. Delaplaine, publisher of the Frederick (Maryland) News and Post; Mrs. Eve C. Leonard, owner of Radio Station WFMD; and Mr. Joseph F. Rhoderick, executive manager of the Frederick Chamber of Commerce, recently at a retreat parade held at Fort Detrick. Colonel Joseph C. Prentice, Acting Commander, made the presentations, and at the same time presented the Chemical Corps Certificate of Achievement to Mr. Joseph Schwimmer, Assistant to the Commander for Information and Public Affairs.

The newspapers and radio station were cited for their patriotic civilian service to the U.S. Army Biological Warfare Laboratories, the Chemical Corps and the Army. Mr. Rhoderick was cited for his unselfish assistance to personnel of Fort Detrick in maintaining the outstanding community relations program which ties in Fort Detrick to the community.

PAPER SUITS FOR FIRE-FIGHTERS

An expendable aluminized suit for the protection of fire-fighters was used successfully in large scale tests conducted recently in California forests by the U.S. Army Research and Development Laboratories, Fort Belvoir, Virginia, according to a Department of the Army announcement.

Preliminary reports indicate that men wearing the suit over duty uniforms were able to stand within two feet of a forest fire for two to three minutes without discomfort, although the heat was so intense that exposed portions of helmet liners were blistered.

The expendable suit is made of flame retardant treated aluminized kraft paper. It was exhibited along with other new developments at the 13th annual meeting of A.F.C.A. at Atlantic City last June.



CHEMICAL CORPS NEWS

ARMY RESEARCH CHIEF CITES IMPORTANCE OF STUDY OF CHEMICAL AND BIOLOGICAL AGENTS

Lt. Gen. Arthur G. Trudeau, Chief of Research and Development, Department of the Army, addressing the 4th Annual Meeting of the Association of the United States Army, in Washington, D.C., 22 October, 1958, named the subject of chemical and biological agents as one of seven major fields of basic research in which the Army is engaged. His introductory remarks as moderator of a panel discussing "The Army Looks at the Future," included this statement:

"Chemical and biological warfare is a most vital part of our research. I believe that chemical and

biological agents have great potential in any type of warfare. Chemical and biological agents usable against personnel, animals and agriculture are being carefully studied. Defense against these agents is very difficult but very important and we feel that we must vigorously push this entire program in view of indications of Russian intent to employ some or all of them in war."

The other areas for Army basic research named by Gen. Trudeau were: human factors, medicine, nuclear effects, arctic environment, upper atmosphere exploration and nuclear reactors.

1st LIEUT. ALLEN H. LIGHT, JR., HONORED AT INFANTRY SCHOOL

First Lieutenant Allen H. Light, Jr., Chemical Corps officer, was Honor Graduate of the Infantry School's associate company officers class at Ft. Benning, Georgia, graduating this summer. Receiving his Regular commission some 18 months ago at Dugway Proving Ground, Utah, Lieutenant Light is serving his initial two-years tour with a combat arm.

CHEMICAL CORPS INSTRUCTORS MEET

FORT McCLELLAN, Ala.—There were approximately 100 visiting Chemical Officers at the Fifth Annual Chemical Instructors Conference held here at U.S. Army Chemical Corps School August 12 and 15. The latest trends in equipment, doctrine and development were stressed during the four days program of seminars and lectures.

At Instructors Conference at Fort McClellan, Ala., (left to right) Lt. Col. John L. Carson, Plans & Doctrine, OCCmIO; Col. Carl V. Burke, commandant of the School; Col. John M. Palmer, commanding officer, Chemical Corps Training Command; and Col. Robert W. Breaks, chemical officer, Continental Army Command, Ft. Monroe, Va.



RAD CONTROL CENTER UNITS ESTABLISHED BY CML. CORPS

FORT McCLELLAN, Ala., (ANS)—A small team-type organization called the Radiological Control Center has been developed by the U. S. Army Chemical Corps School here to plot and predict radioactive fallout and to evaluate radiological monitoring and survey data in a combat zone.

Announced recently by the Army, the units—called "RADC's"—will be composed of one officer and four enlisted men, and will be established at Field Army, Corps, and Division levels.

Functioning with speed, accuracy and skill, each unit will predict fallout from enemy weapons, as well as evaluate and disseminate radiological data for its area based on readings taken and reported by ground and aerial monitors.

TRIPARTITE CONFERENCE DISCUSSES CBR DEFENSE

Representatives of the Department of Defense, Army, Navy, and Air Force composed a United States delegation attending the 13th Annual Tripartite Conference September 15-25 in Canada to discuss chemical, biological, and radiological defense, the Department of Defense announced.

The conference is held annually by the United States, Canada, and the United Kingdom, with each one acting alternately as host. It is one of a number of conferences held each year by the three countries on mutual defense matters.

The discussions were held at the Canadian Defence Research Board's Suffield Experimental Station near Medicine Hat, Alberta, and at the Board's headquarters in Ottawa.

The Tripartite conferences serve as the medium for the direct exchange of technical and scientific information and as a focal point for the coordination of research and development for the three countries. This pooling of scientific effort plays an important role in accomplishing the standardization of items and equipment of the three nations, a basic purpose of the tripartite agreement.

This cooperation dates back to early in World War II when scientists from the three countries met informally in small groups to exchange information and to coordinate research relative to toxicological defense. These meetings were the forerunners of the present Service-wide Tripartite conferences.



Receiving the Commanding Officer's Annual Safety Award Plaque of the Memphis General Depot from Colonel Harry F. Hansen (left), Acting Depot Commander, is Colonel Willis G. Robbins (right), Chief, Chemical Supply Section.

COL. BARKSDALE COMMANDS EASTERN CHEMICAL DEPOT



EDGEMOOR, Md. — Colonel Stoessel S. Barksdale, former member of the staff and faculty of the U.S. Army War College at Carlisle Barracks, Pennsylvania, has assumed command of the U.S. Army Chemical Depot, Eastern, at the Army Chemical Center.

A native of Alabama, he is an alumnus of the University of Alabama.

During World War II, Col. Barksdale was assigned to the 87th Division, Third Army, and participated in the Rhineland, Ardennes-Alsace, and Central Europe campaigns. His decorations include the Bronze Star Medal, the Purple Heart, and Commendation Ribbon with metal pendant.

CHEMICAL SECTION WINS MEMPHIS SAFETY AWARD

The Commanding Officer's Annual Safety Award for 1958 was presented to the Chemical Supply Section of Memphis General Depot for outstanding safety achievement.

In addition to this honor, Colonel Willis G. Robbins received for the Chemical Section the safety award for the fourth quarter of fiscal year 1958. This was the third consecutive quarter the Chemical Supply Section had won this distinction.

In presenting the award to Colonel Robbins, Colonel

William D. Buchanan, depot commander, said: "... During the 18 month period, employees under your supervision sustained no disabling injuries and only two minor injuries; and were not involved in any property damage accidents."

This is the second year the Chemical Supply Section has won the award, the last time being in 1955.

COL. ARTHUR TO ATTEND NATIONAL WAR COLLEGE

Colonel Frank M. Arthur who has been serving as chief of the Career Management Division, Office of the Chief Chemical Officer, has been assigned as a student in the current course at the National War College, located at Fort Lesley J. McNair, Washington, D.C.

In the September-October issue of THE JOURNAL, it was erroneously stated that Colonel Arthur's new assignment was to attend the Army War College at Carlisle Barracks, Pa.

MR. ZAVEN NALBANDIAN, LONG WITH CML. CORPS INTELLIGENCE, RETIRES

Mr. Zaven Nalbandian, Technical Consultant, Chemical Corps Intelligence Agency, retired on September 30 after more than three decades with the Chemical Corps.

Mr. Nalbandian, an industrial chemist, was commissioned in the Chemical Warfare Reserve in 1923 and was in continuous reserve or active service until 1946 when he returned to civilian status, but remained with the Chemical Corps.

During World War II Mr. Nalbandian served, with the rank of Major, first at Edgewood Arsenal, Md., in the Research and Development division of the Technical Command, and later in the Chief's Office in Washington, in the Intelligence Branch, War Plans & Theatres of Operation Division. He has received the Army Commendation Ribbon, and the Civilian award for Meritorious Service.

Mr. Nalbandian is a graduate of Harvard, and has a Master's degree from Columbia University. Besides English, and his native Armenian, he is versed in some ten languages, including Russian, German and French. He is a charter member of the Armed Forces Chemical Association.



—Photo by Fabian Bachrach

DETTRICK SAFETY OFFICIAL WINS STUDY FELLOWSHIP

Mr. G. Briggs Phillips, Assistant Chief of Agent Control Branch, Safety Division, Fort Detrick, has been awarded the Secretary of the Army's Research and Study Fellowship.

Beginning in January, Mr. Phillips will study methods dealing with the prevention of laboratory-acquired illnesses among scientists. These studies will take him to England, Sweden, Canada and various areas of the United States, according to the Chemical Corps announcement.

Mr. Phillips is the second Fort Detrick scientist to receive this high Army honor, and the fourth in the entire Chemical Corps. He is a graduate of the University of Maryland, class of '54. He was awarded a B.S. degree.

AN ODE TO THE SCREEN IN FOUR TWENTY-SIX

LEROY D. FOTHERGILL*

THE jaunty Colonel strode jauntily to the podium,
"Greetings, my comments will be kept to a modicum.
So welcome, gentlemen, welcome to this briefing,
Enjoy all our comforts, our food and our drinking.
Now, first, I'll discuss our organization,
Slide No. 1, please, by way of elucidation."

Down, down, down toward the floor,
Slowly, noisily, it's beginning to bore,
 Into my psyche,
 With the speed of a Nike.
 It isn't just hazy,
 It's driving me crazy,
That screen that seems so fixed,
To the wall in four twenty-six.

There were directors, execs, deputies and PIO's,
Intelligence, procurement, personnel and provos.
 We all could have done
 With one that was none.
 'Tis a chaplain I mean
 To keep us on beam.

"This is an outline of our present administration,
Who knows when we'll have another reorganization.
And now to our briefing—
Our chief scientist will be speaking."

The lights flickered on
And up started the screen.
The trauma has started—brain-washing
 it would seem,
Like the drip, drip, drip of water
Upon the condemned head
Seated in the torture chamber
Wishing he were dead.

Where, oh where, is there a scientist who can give a talk
Unadorned by charts and slides and a box of colored
 chalk?

And so, he too starts out by saying,
"The first slide, please, by way of illustrating."
And then the downward plunge of that screen is started
 once more.
I shudder and cringe and ask myself, will it ever reach
 the floor?

Down, down, its inevitable creeping,
Noisily groaning, scraping and creaking,
Like grains of sand rolling to and fro
By every wave made to go

It is maddening, it is so endless
For a captive audience so defenseless.
At last, the bottom is reached with a thump,
Relieving tensions with an emotional bump.

The General leaned forward with a grimacing stare,
It was obvious to all—he was filled with despair.
He grunted and groaned and cleaned his pipe;
"A hell of a slide," he said, "Remove it from sight!"

Up, up, up, on another ascent,
Squeaking and crawling so indolent.
Not even a general can hasten its way
 Its continual erosion
 On our strained emotion
Seems destined to stay here forever and a day.

I cringe, I shudder, I pray and I hope,
That someone will be found able to cope,
With that screen that seems so fixed
To the wall in four twenty-six.

*The author, Dr. Fothergill, is Scientific Advisor for Biological Warfare, to the Chief Chemical Officer, on duty at Fort Detrick, Maryland—Ed.



SCHOOL AUDITORIUM NAMED IN HONOR OF COL. JOS. D. COUGHLAN

FORT McCLELLAN, Ala.—The dedication of Coughlan Auditorium in honor of the late Colonel Joseph D. Coughlan was held at the U.S. Army Chemical Corps School here on August 13.

During the ceremony Mrs. Joseph D. Coughlan, of

Lebanon Springs, New York, the widow of Colonel Coughlan, unveiled a bronze memorial plaque officially naming the auditorium.

Col. John M. Palmer, commanding officer of the U.S. Army Chemical Corps Training Command, Col. Carl V. Burke, commandant of the School, and Chaplain (Maj.) John F. Orzel, (left to right in picture with Mrs. Coughlan) participated in the ceremonies.

A 1915 graduate of the U.S. Military Academy, Colonel Coughlan won the Silver Star while serving with the Second Division as a Field Artillery Officer in World War I. He transferred to the Chemical Corps in 1931. During World War II Colonel Coughlan served as chemical officer of the First U.S. Army in the United States, England and France. Other assignments he had included: Assistant Commandant of the Chemical Warfare School; chemical officer Hawaiian Department; chemical officer Eastern Defense Command, and professor of Military Science and Tactics at Texas A&M College. His last active duty assignment was as an instructor at Camp Sibert, Alabama, before he retired in January 1946. He died in September 1951.

NEW ORO-NASAL MASK HAS MANY USES



A new, more effective type of oronasal air filtering mask (one which covers the nose and mouth of the wearer) has been developed by the U.S. Army Chemical Corps.

The mask was designed primarily for use in testing the filtering efficiency of experimental biological and chemical warfare protective masks. It has been

used for several years and has proved physically rugged without deteriorating after prolonged wearing. Because of this and its high efficiency, it appears that it may be suitable for a wide variety of other uses.

The new mask has proved to be 10 to 15 times more effective in filtering out air-borne bacteria than the conventional surgical mask, according to its developers, Mr. Charles J. Shoemaker and associates of the Protective Development Division, Chemical Warfare Laboratories, Army Chemical Center, Md.

The oronasal mask, designed for simplicity of manufacture and low cost, is held to the face by a flat sheet of surgical-type adhesive tape to form an airtight seal against the face. The filter material, also developed by the Army Chemical Corps, is waterproof and consequently moisture from the breath does not affect its performance. The filter is pleated to increase its area in order to lessen its resistance to breathing, yet it does not interfere with normal face movements or speech. Unlike conventional contagion masks, this mask does not fog eye-glass lenses.

Extensive laboratory use and field trials indicate that skin irritation from prolonged wearing is virtually nonexistent. Some skin irritation may be caused by the tape, however, when the mask must be replaced frequently.

Possible applications of the mask are as a contagion mask to prevent exposure to toxic bacteria or when environmental sterility is mandatory; as a dust mask; an emergency mask, or (after slight alteration in manufacturing techniques) as an odor protection mask.

KOREA CHEM. SECTION WAGES A SPRAY WAR ON MOSQUITOES

KOREA, (ANS)—The Chemical Section, I Corps (Group) has launched a nightly spraying attack to combat the current encephalitis menace here. Special teams using smoke generators, spray all I Corps (Group) areas and Korean villages nearby, using a mixture of DDT, kerosene, and fog oil.

The teams spread their mosquito-killing fog for approximately two hours each night. A spokesman said the spraying will continue until the insect season ends.



Dr. David Grob (center) exhibits award following presentation ceremony at Army Chemical Center. At left, Col. L. E. Fellenz, Commander of Chemical Warfare Laboratories; at right, Dr. David B. Dill, Deputy Director of Medical Research.

CITED FOR NEW METHODS OF TREATING NERVE GAS CASUALTIES

New methods of treating chemical warfare casualties have resulted from pioneer research on the mechanism of action of nerve gases conducted by Dr. David Grob while Associate Professor of Medicine at Johns Hopkins University. This, as well as other outstanding accomplishments is cited in a Certificate of Achievement which was presented to Dr. Grob on August 29 by Col. L. E. Fellenz, Commanding Officer of the U.S. Army Chemical Warfare Laboratories at Army Chemical Center.

Dr. Grob's work for the Chemical Corps, carried out under contract, also included investigations dealing with the usefulness of nerve gases in the treatment of diseases of muscles and of the nervous system. It is noted also that he was the first to use volunteers to study the action of nerve gases and the effectiveness of atropine, oximes, and other therapeutic drugs in treating nerve gas poisoning.

Dr. Grob, a native New Yorker, served in Europe in World War II as battalion surgeon with the 12th Infantry Regiment, 4th Division. He recently resigned as Associate Professor at Johns Hopkins to accept appointment as Director of Medical Services at the Maimonides Hospital, Brooklyn, and as Professor of Medicine in the State University of New York.

EYE TEST FOR CIVILIANS

EDGEGOOD, MD.—A program to extend health and welfare benefits to all civilian employes at the Army Chemical Center has been inaugurated here. All jobs on post have been analyzed for visual requirements and all personnel will be given an eye test.

A special instrument designed to measure visual skills, that is portable and can be taken from one agency to another, is used. Employes found to have visual deficiencies will be referred to their eye doctors for examination at the expense of the employes. However, those on jobs classified as "eye hazardous" will be provided with safety glasses by the government.

The program, which in no way will jeopardize an employe's job, was requested by Post Commander Brigadier General Harold Walmsley, Post Surgeon Colonel Frank W. Threadgill, and Post Safety Officer English. This is an additional service provided to enable employes to perform their jobs more efficiently and safely.

THE

HISTORICAL CORNER

By DR. BROOKS E. KLEBER
U. S. Army Chemical Corps, Historical Office

Flame Action In Buna

I GUESS its only human to select incidents for this column which depict Chemical Corps personnel and munitions in the very best light—actions which reveal the ingenuity and value of the weapons and the gallantry and sacrifice of the men. But this approach does not always present a true picture of events as they happened. The early performances in World War II of the portable flame thrower, for example, included some glaring cases of weapons failure.

The first combat employment of the portable flame thrower, according to Chemical Corps Historical Office records, took place in December 1942 near the village of Buna, in eastern New Guinea. The flame thrower was called upon to help overcome an enemy machine gun position which was holding up an element of the 126th Infantry, 32d Division. The engineer battalion, equipped with the E1R1 model (which became the M1), tested and serviced its flame throwers and sent forward five operators and two weapons. Although the tests had revealed some leaks in the gas cylinders, probably caused by rust, the flame throwers had worked reasonably well, if at a maximum range of only twenty yards.

Meanwhile, M/Sgt. John K. King of the 32d Division Chemical Section and an infantry lieutenant went forward on reconnaissance. The two men intentionally exposed themselves in order to pinpoint the enemy bunker skillfully concealed at the edge of a field of kunai grass. The lieutenant repeated this dangerous performance to show the bunker's exact position to Cpl. Wilber G. Tirrell, the engineer flame thrower operator who was to make the assault.

The plan of attack was simple. A diversionary party of three men with automatic weapons was to crawl around the left flank and fire at the rear of the bunker. Corporal Tirrell, taking advantage of an old breastworks thirty-five yards from the bunker and a shallow trench which extended for five more yards, would arise from this attack position, advance five yards, and begin flaming the enemy. In the wake of the flame thrower, the lieutenant, Sergeant King, and four riflemen, would storm the bunker from initial positions behind the breastworks.

Tirrell checked his flame thrower, and the men took their places.

At the precise moment the diversionary party opened fire; Tirrell moved from the trench, advanced seven yards, and fired his flame thrower; and the supporting group rushed from behind the breastworks. All according to plan, with but one exception—the flame thrower emitted a feeble squirt that carried less than a dozen feet.

The enemy machine gun killed the lieutenant and wounded a rifleman; the rest withdrew. Tirrell reso-

lutely continued forward, vainly attempting to fire his flame thrower. He got within fifteen yards of the bunker before falling to the ground, stunned by a bullet striking his helmet. That night he crawled to safety. (Indicative of the confusion of jungle fighting is the fact that Tirrell initially was reported dead.) Two days later the infantry took the position by direct assault.

Fortunately, the portable flame thrower recovered from the initial reputation caused by this incident. The efforts of competent staff chemical officers, the hard work of maintenance men, and the arrival of better models from the zone of interior resulted in a weapon fully respected in the Pacific for its effectiveness in overcoming stubborn Japanese positions.

WIFE OF COL. DYKES, FORMER AFCA DIRECTOR, DIED AUG. 17

Mrs. Willie G. Dykes, wife of Lt. Colonel Claude B. Dykes, director of depot operations at the Pine Bluff Arsenal and formerly a Director-at-Large of Armed Forces Chemical Association, died at the Davis Hospital in Pine Bluff on 17 August last. Notice of Mrs. Dykes' death was received too late for inclusion in the last issue of THE JOURNAL.

Mrs. Dykes, who was a native of Alabama, joined the Army Nurse Corps during World War II; served in the Pacific Theater and later in Berlin during the airlift Operation VITTLES, receiving her discharge in 1954 with the grade of Captain.

NEW COMPTROLLER AT ACC



Colonel James E. McHugh, a native of Rochester, N.Y., has been named comptroller at Army Chemical Center at Edgewood. Col. McHugh comes here from an assignment in the Office of the Chief Chemical Officer in Washington. He replaces Col. L. A. Parks, who has been transferred to Fort McClellan, Alabama.

COL. BOYLES, NEW COMMANDER OF 100TH CHEMICAL GROUP

FORT McCLELLAN, Ala. — Colonel S. Julian Boyles, who has served as deputy commander of the U.S. Army Chemical Corps Training Command since August 1957, assumed command of the 100th Chemical Group (ComZ) here August 19.

He replaces Col. Marvin A. Middlebrooks, now assigned as Chemical Officer, First Logistical Command, Fort Bragg, N.C.

Colonel Boyles has an engineering degree from North Carolina State University, and is a graduate of the Command and General Staff College and the Armed Forces Staff College.

During World War II, he was a chemical officer of the 91st Infantry Division in Italy, receiving the Bronze Star Medal and other combat service awards. Among his assignments since the war was that of Chemical Officer, U.S. Army, Europe.



GROUP AND SUSTAINING MEMBERS

OF THE ARMED FORCES CHEMICAL ASSOCIATION

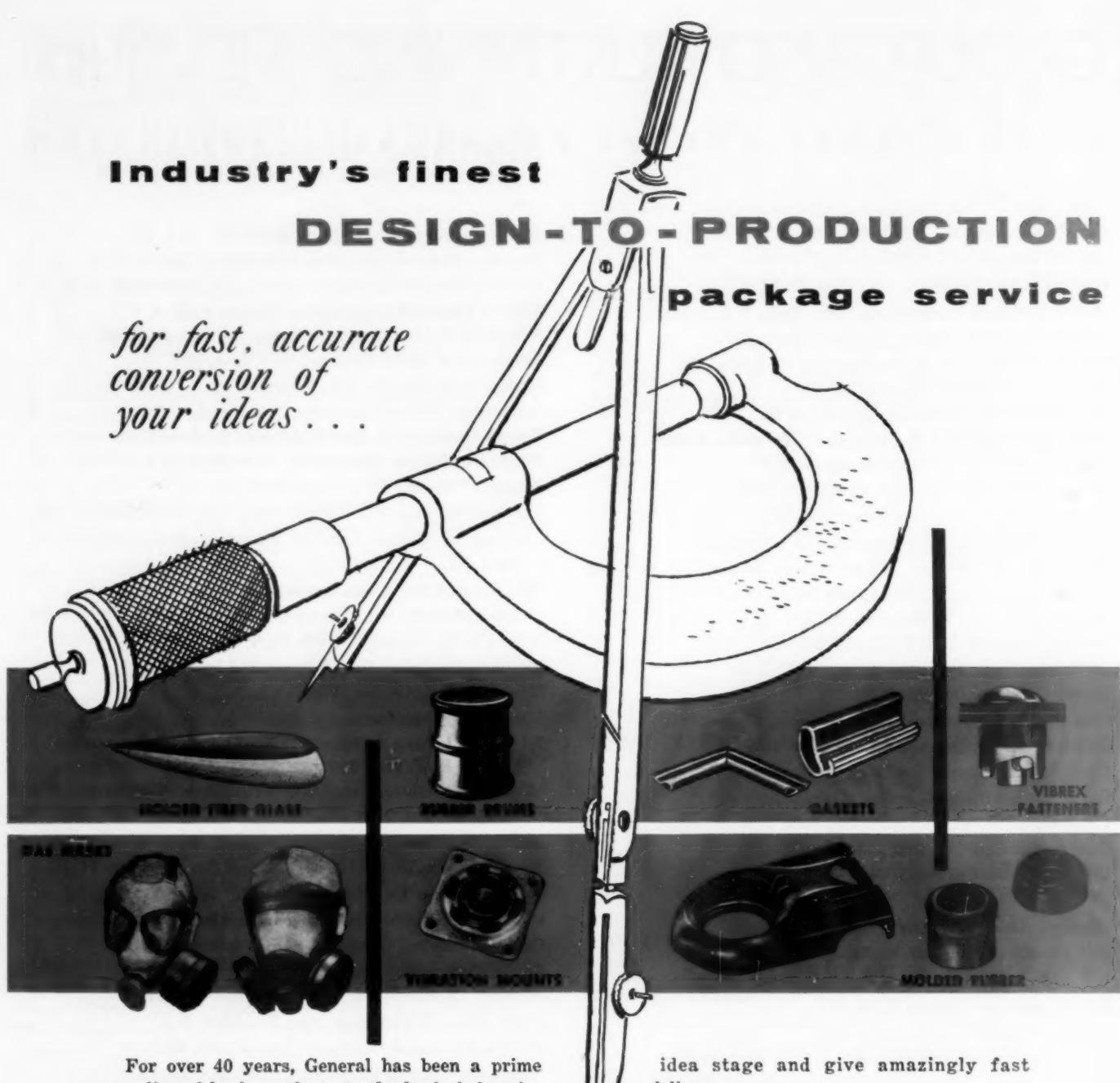
Abbott Laboratories, North Chicago, Ill.
Adache Associates, Inc., Engineers, Cleveland, Ohio
Air Reduction Company, Inc., New York, N.Y.
Allied Chemical Corporation, New York, N.Y.
American Cyanamid Company, New York, N.Y.
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Celanese Corporation of America, New York, N.Y.
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Edo Corporation, College Point, N.Y.
Engelhard Industries, Newark, N.J.
Esso Research and Engineering Co., New York, N.Y.
Evans Research & Development Corp., New York, N.Y.
Federal Laboratories, Inc., Saltsburg, Pa.
Ferguson, H. K., Company, The, Cleveland, Ohio
Ferro Corporation, Cleveland, Ohio
Firestone Industrial Products Co., Fall River, Mass.
Fisher Price Toys, Inc., East Aurora, N.Y.
Fisher Scientific Co., New York, N.Y.
Fluor Corporation, Ltd., The, Whittier, Calif.
Food Machinery & Chemical Corporation, New York, N.Y.
Foster Wheeler Corporation, New York, N.Y.
Fraser & Johnston Co., San Francisco, Calif.
General Aniline & Film Corporation, New York, N.Y.
General Electric Company, Chemical & Metallurgical Division, Pittsfield, Mass.
General Tire & Rubber Company, The, Wabash, Ind.
Goodrich, B. F., Chemical Company, Cleveland, Ohio
Handy & Harman, New York, N.Y.
Harshaw Chemical Company, The, Cleveland, Ohio
Harvey Aluminum, Torrance, Calif.
Hercules Powder Company, Wilmington, Del.
Heyden Newport Chemical Corporation, New York, N.Y.
Hooker Chemical Corporation, Niagara Falls, N.Y.
Industrial Rubber Goods Company, St. Joseph, Mich.
International Nickel Co., Inc., New York, N.Y.
International Salt Co., Inc., Scranton, Pa.
International Silver Company, The, Meriden, Conn.
Kaiser Aluminum & Chemical Corp., Oakland, Calif.
Kennecott Copper Corporation, New York, N.Y.
Koppers Company, Inc., Pittsburgh, Pa.
Lambert-Hudnut Mfg. Laboratories, Inc., Lititz, Penna. subsidiary of Warner-Lambert Pharmaceutical Company, St. Louis, Mo.
Eli Lilly and Co., Indianapolis 6, Ind.
Little, Arthur D., Inc., Cambridge, Mass.
Mason, L. E., Company, Hyde Park, Mass.
Merck & Company, Inc., Rahway, N.J.
Miles Laboratories, Inc., Elkhart, Ind.
Mine Safety Appliances Co., Pittsburgh, Pa.
Minnesota Mining & Manufacturing Co., 900 Fauquier Avenue, St. Paul, Minnesota
Miracle Adhesives Corp., 250 Pettit Ave., Bellmore, Long Island.
Monsanto Chemical Company, St. Louis, Mo.
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Proctor & Gamble, Cincinnati, Ohio.
Reynolds Metals Company, Louisville 1, Ky.
Shea Chemical Corp., Jeffersonville, Ind.
Shell Chemical Corp., Denver, Colo.
Shell Development Company, Emeryville, Calif.
Sheller Mfg. Co., Dryden Rubber Div., Chicago, Ill.
Shwayder Bros., Inc., Denver, Colo.
Standard Oil Company (Indiana), Chicago, Ill.
Stauffer Chemical Company, New York, N.Y.
Sun Oil Company, Philadelphia, Pa.
Union Carbide Corporation, New York, N.Y.
United-Carr Fastener Corp., Cambridge, Mass.
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